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Docket OW-2002-0049 DCN# 6-2059

MBC Applied Environmental Sciences  
National Pollutant Discharge Elimination System 2001  
Receiving Water Monitoring Report: AES Redondo  
Beach L.L.C. Generating Station, Los Angeles County,  
California. 2001 Survey. Prepared for AES Redondo  
Beach L.L.C. March.

# NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM 2001 RECEIVING WATER MONITORING REPORT AES REDONDO BEACH L.L.C. GENERATING STATION LOS ANGELES COUNTY, CALIFORNIA

**2001 Survey**

**Prepared for:**

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**March 2002**

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## EXECUTIVE SUMMARY

The 2001 National Pollutant Discharge Elimination System (NPDES) marine monitoring program for the AES Redondo Beach L.L.C. generating station (formerly called the Redondo Generating Station and a subsidiary of AES Corporation) was conducted in accordance with specifications set forth by the California Regional Water Quality Control Board, Los Angeles Region (LARWQCB) in NPDES Permit No. CA0001201 dated 29 June 2000. The 2001 studies included physical monitoring of the receiving waters and underlying sediments, biological sampling of benthic infaunal assemblages, mussels, and fish and macroinvertebrates, including impingement and video-cine transect studies. Results of the 2001 surveys were compared among stations and with previous studies to determine if the beneficial uses of the receiving waters continue to be protected.

### WATER COLUMN MONITORING

Water quality parameters measured during the 2001 surveys in King Harbor and Santa Monica Bay were all within ranges recorded in previous surveys. During winter and summer, temperatures in King Harbor were higher than offshore, which is expected in a relatively small, semi-enclosed water body where water exchange with the open ocean is somewhat limited. Afternoon temperatures were slightly higher than morning temperatures during both surveys, the result of solar warming, and thermoclines were recorded in the harbor and offshore in both surveys. Dissolved oxygen (DO) concentrations were slightly higher offshore than in the harbor during both surveys; the slightly higher concentrations recorded in the afternoon probably resulted from increased primary production. Slightly higher subsurface DO concentrations at several offshore stations in winter likely resulted from a plankton bloom (red tide) observed in the study area. Hydrogen ion concentration (pH) varied little in the study area, though slight subsurface increases in pH during winter were noted and were also the likely result of increased primary production. All salinity values were within the range of values considered normal in southern California. The only detectable effects from the operation of the AES Redondo Beach L.L.C. generating station were slight increases in temperature at stations nearest the Units 5&6 and Units 7&8 discharges in winter, and at stations nearest the Units 7&8 discharge in summer.

### SEDIMENT MONITORING

#### Sediment Grain Size

Sediments in the study area in 2001 were composed primarily of sand in the fine sand category. Sediments in the study area were coarsest at Station B3, in King Harbor, while sediments from Station B2 (also in King Harbor) were the second finest on record (only exceeded by 2000 results). Results from the 2001 survey suggest sediments in the study area are primarily affected by area-wide and localized oceanographic conditions, such as prevailing nearshore currents, swells, and wave action. The operation of the AES Redondo Beach L.L.C. generating station does not appear to be adversely affecting sediment composition in the study area.

#### Sediment Chemistry

In 2001, as in previous studies, the highest concentrations of chromium, copper, and zinc were found within King Harbor; unlike previous surveys, nickel was found in higher concentrations offshore at Station B6. Offshore, metal levels were also consistently higher than levels noted since 1990. Highest sediment metal levels were generally detected at Station B2, where sediments were finest. Levels were generally higher but more consistent with past surveys than with the 2000 surveys when unusually low levels of metals were detected within King Harbor. The distribution of metals in the study area appeared to be linked to localized sediment grain size and sources

unrelated to the generating station discharges. Most values observed in the present study were well below levels determined to have potentially toxic effects.

### MUSSEL BIOACCUMULATION

Mussel tissue collected at all stations in 2001 contained detectable concentrations of copper and zinc, while chromium and nickel levels remained below the detection limit. Copper levels decreased at both the harbor station and the pier reference station from 2000 levels. Zinc concentrations from the harbor site were the second lowest recorded since 1990 and were below the range of levels noted in the state mussel watch program. All metal concentrations were within levels recorded in similar surveys suggesting the operation of the AES Redondo Beach L.L.C. generating station does not adversely affect metal levels in the study area.

### BIOLOGICAL MONITORING

#### Benthic Infauna

In 2001, the infaunal communities at the King Harbor stations were more abundant and speciose and were different in composition from those offshore in Santa Monica Bay. Density of organisms averaged 22,490 individuals/m<sup>2</sup> in the harbor and 7,900 individuals/m<sup>2</sup> offshore. On average, more than twice as many species occurred at harbor stations than offshore. Within the harbor, the communities at Station B1, at the Units 7&8 discharge, and Station B3, at the harbor entrance, were most similar, with higher abundance and more species than at Station B2, further in the harbor. These differences resulted from the coarser, more poorly sorted sediments containing mollusk and barnacle shell fragments at both the discharge and the harbor entrance. In Santa Monica Bay, where sediments were sandy and well sorted, the communities were similar among the stations. At Station B4, at the Units 5&6 discharge, abundance, species richness and diversity were slightly lower than at the other offshore stations, but the community composition was essentially the same, suggesting little influence from the discharge.

The infaunal communities in the study area were dominated by small annelids, sea anemones, tubesnails and arthropods. *Mediomastus ambiseta*, *M. californiensis*, oligochaetes, *Armandia brevis*, *Notomastus hemipodus*, and *Dorvillea annulata* were abundant at all of the harbor stations, with additional species (anemones, *Caecum californicum* and *C. crebricinctum*) at Stations B1 and B3. Offshore, the communities were dominated by *Apoprionospio pygmaea*, *Spiophanes bombyx*, *Mediomastus acutus*, *Rhepoxynius menziesi*, and *Diastylopsis tenuis*. These communities have been present in the study area since 1978, and are typical of harbor and sandy, nearshore subtidal habitats in the Southern California Bight. Community abundance and composition were similar to those in previous surveys, and appear to reflect sediment characteristics. The generating station discharges did not appear to influence the infauna communities, except at station B1, where turbulence from the discharge undoubtedly affects sediment characteristics, resulting in an abundant, diverse community.

#### Fish and Macroinvertebrates

##### Video-cine Transects

Video-cine transects in 2001 at the Units 7&8 discharge and along the breakwater inside King Harbor resulted in observation of over 5,600 fish representing 28 species, and almost 130 motile macroinvertebrates representing nine species. Over 92% of all fish individuals were seen at the discharge stations rather than at the breakwater control station; however, species richness was similar. Nine species each comprised more than one percent of the abundance and together accounted for almost 97% of the individuals observed. Three species, blacksmith, sargo, and

senorita, comprised almost 83% of the total. Kellet's whelk, warty sea cucumber, and wavy topsnail were the most abundant motile macroinvertebrates, and together accounted for more than 88% of the individual invertebrates. Fish species richness in 2001 was the highest in the long-term record, but abundance was intermediate and just below the long-term mean. The fish communities at the discharge and along the breakwater were similar to those observed during previous surveys with the addition of three new species, Pacific angel shark, California barracuda, and cabezon, all common Southern California Bight fauna. The continued high abundance and diversity of the fish populations in King Harbor, especially near the discharge, indicated that the operation of the generating station is not adversely affecting these populations.

### **Fish Impingement**

The fish and macroinvertebrates species taken in impingement catches in 2001 indicated healthy, diverse populations in King Harbor. A total of 57 species and over 9,000 individuals amassing a weight of over 1,700 kg were taken. The occurrence of these species throughout the Southern California Bight, and their continued abundance and high species diversity at the generating station indicated that operation of the AES Redondo Beach L.L.C. generating station is not having an appreciable adverse effect on the diverse fish and macroinvertebrate populations in the study area.

### **CONCLUSIONS**

The overall results of the 2001 NPDES monitoring program indicated that operation of the AES Redondo Beach L.L.C. generating station had no detectable adverse effects on the beneficial uses of the receiving waters.

## INTRODUCTION

This report presents and discusses the results of the 2001 receiving water monitoring studies conducted for the AES Redondo Beach L.L.C. generating station, a subsidiary of the AES Corporation, formerly called the Redondo Generating Station. The 2001 monitoring program was conducted in accordance with specifications set forth in National Pollutant Discharge Elimination System (NPDES) Monitoring and Reporting Program No. 0536 (Permit No. CA0001201) issued by the California Regional Water Quality Control Board, Los Angeles Region (LARWQCB) on 29 June 2000 (Appendix A). Results of the 2001 surveys were compared among stations and with past physical oceanographic and biological studies to determine what effects, if any, the generating station discharge is having on the marine environment, and if the beneficial uses of the receiving waters are being protected. Sampling included physical and chemical monitoring of the receiving waters and sediments, mussel bioaccumulation, and biological monitoring of infaunal assemblages and fish and macroinvertebrate populations via impingement and video-cine transect studies.

## DESCRIPTION OF THE GENERATING STATION

The AES Redondo Beach L.L.C. generating station is located adjacent to King Harbor in the City of Redondo Beach, County of Los Angeles. The generating station consists of four steam electric generating units; two units (Units 5&6) are rated at 175 megawatts (Mw) each and two (Units 7&8) are rated at 480 Mw each. Units 1-4 have been removed from operation since October 1987 resulting in a total station rating of 1,310 Mw; however, the plant operated at 55.2% of capacity in 2001 (Gusters and Loveland 2001, pers. comm.).

Ocean water for cooling purposes is supplied to the station via two cooling water systems, one serving Units 5&6, and one serving Units 7&8. The flow is directed to two screening facilities within the plant: one screening facility serves Units 5&6 and the second serves Units 7&8. The screen systems are designed to remove trash, algae, marine life, and other detrital material incoming with the cooling water. After leaving the screens, the cooling water is pumped to two steam condensers, one per turbine-generator.

Approximately 320,000 gallons per minute (gpm) of seawater enter Units 5&6 from King Harbor via one, three-meter (3-m) inside diameter (ID) concrete conduit. In passing through the condensers, the temperature of the cooling water is elevated 12.8°C at Units 5&6, when the units are operating at full load. The temperature increase is less at lower loads. The warmed water is directed to a concrete discharge conduit, with a 3-m ID, and extending approximately 500 m offshore (i.e., outside King Harbor). The discharge terminates at a depth of approximately 7.6 m. In normal operation, Units 5&6 use the Units 5&6 intake in the harbor and discharge through the old Units 1-4 south tunnel offshore. The Units 1-4 intake in the harbor and the Units 5&6 discharge offshore remain on standby for contingency use by the power plant and the Redondo Marine Laboratory.

Approximately 468,000 gpm of seawater is supplied to Units 7&8 from a 4.25-m-ID concrete conduit, which originates about 600 m offshore at the mouth of King Harbor. This cooling flow passes through a screening facility and is directed to two steam condensers, one per turbine generator. In the condenser, the temperature of the cooling water rises 12.0°C when the units are operating at full load. The temperature increase is lower at reduced loads. The warmed water is then directed to a 4.25-m-ID discharge conduit, which discharges 50 m offshore within Redondo Beach King Harbor at a depth of approximately six meters.

Units 5&6 and 7&8 both have closed cooling-water systems to cool auxiliary equipment in each plant. The closed system uses de-mineralized water which is cooled in turn by part of the main cooling water streams, which is diverted to a heat exchanger and subsequently returns to the main cooling water flow. Units 5&6 divert 5,000 gpm, which is raised 5.0°C; Units 7&8 divert 15,000 gpm, which is raised 5.6°C.

During the winter survey period, 19 March 2001, the AES Redondo Beach L.L.C. generating station operated two circulating pumps for Units 5&6, and four circulating pumps for Units 7&8. The cooling water discharge through Units 5&6 was approximately 106.6 million gallons per day (mgd). The temperature at the intake, located in the harbor, was 11.4°C and the discharge temperature was 27.3°C, imparting a temperature differential of 15.8°C. Units 7&8 discharged approximately 673.9 mgd with an intake temperature of 16.4°C and discharge temperature of 21.8°C, imparting a temperature differential of 5.4°C (Gusters and Loveland 2001, pers. comm.).

During the summer survey period, 19 September 2001, the generating station operated six circulating pumps. Units 5&6 operated two pumps and discharged approximately 106.6 mgd. Temperatures at the intake and discharge were 17.3°C and 16.7°C, respectively, imparting a temperature differential of -0.6°C. Units 7&8 operated four pumps and discharged approximately 673.9 mgd. Temperature at the intake, located at the harbor entrance, was 20.7°C and the discharge temperature was 31.8°C, with a temperature differential of 11.1°C (Gusters and Loveland 2001, pers. comm.).

## **DESCRIPTION OF STUDY AREA**

### **Location**

The AES Redondo Beach L.L.C. generating station is located in the City of Redondo Beach on the southern shore of Santa Monica Bay, California. The study area includes approximately five square miles of ocean surrounding the offshore cooling water intake and discharge conduits, and King Harbor, in which two cooling water intakes and one discharge are located. The physiography, climate, and hydrography of the southern California coastal region all contribute to the character of the study area. The fate of thermal discharges to coastal waters is influenced by the interaction of oceanographic and meteorological elements, both of which have short- and long-period cyclical variations, as well as non-periodic trends and events. Winds, tides and currents are particularly important since they have the greatest effect on the fate of thermal plumes.

### **Physiography**

The general orientation of the coastline between Point Conception and the Mexican border is from northwest to southeast. The continental margin has been slowly emerging over geological time, resulting in a predominantly clifffed coastline, which is broken by coastal plains in the Oxnard-Ventura, Los Angeles, and San Diego areas. Most drainage of the coastal region is via short streams, which normally flow only during rain storms. However, only a small part of the storm runoff reaches the ocean directly; most is impounded by dams or diverted for other uses.

The eight islands offshore southern California also influence water circulation and oceanographic characteristics along the mainland coast. The mainland shelf is narrow along the coast, ranging from less than 1.6 kilometers (km) to more than 15 km wide, and averaging approximately 7 km. Seaward of the shelf is an irregular, geologically complex region known as the continental borderland, comprising basins and ridges which extend from near the surface to depths in excess of 2,400 m.

Marked changes in bottom topography close to shore affect current speeds and directions. The ocean topography offshore from the AES Redondo Beach L.L.C. generating station is distinguished by the presence of the Redondo Submarine Canyon. Submarine canyons often enhance onshore and offshore bottom water transport and serve as pathways for migratory fish and invertebrates. The canyon also influences wave refraction and nearshore currents. The predominant water flow in Redondo Submarine Canyon in 1969 was up-canyon and at an average current speed of about 2.5 centimeters per second (cm/s) (Shepard and Marshall 1973).

Investigations of tidal currents in Santa Monica Bay indicated that the lowest current velocities were over Redondo Submarine Canyon and near its head (Allan Hancock Foundation 1965). The highest velocities were over central parts of the shelf. Figure 1 depicts isolachs of theoretical maximum speeds of tidal currents in Santa Monica Bay.

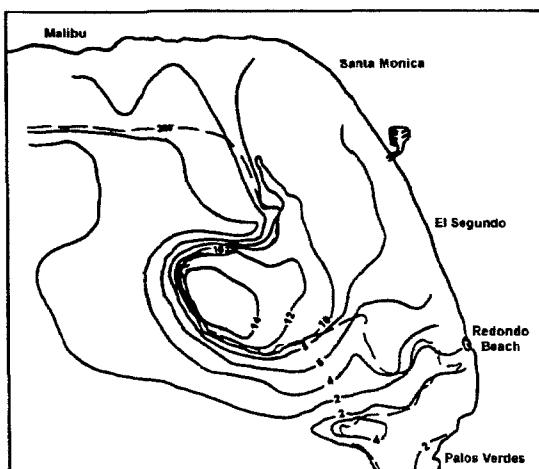


Figure 1. Theoretical maximum speed of tidal currents in Santa Monica Bay. AES Redondo Beach L.L.C. generating station NPDES, 2001.

offshore into the heads of submarine canyons. King Harbor is just north of Redondo Submarine Canyon, and the mouth of the harbor is situated directly adjacent to the head of the canyon. Thus, sand moving south towards the harbor tends to divert into the canyon. For this reason, beaches from King Harbor to Palos Verdes Peninsula must be sustained by beach replenishment. Outside King Harbor, the study area is typical of Santa Monica Bay. Wave refraction due to bottom topography and the harbor breakwater probably influences the nearshore drift of the thermal plume.

### Climate

Southern California lies in a climatic regime broadly defined as Mediterranean, which is characterized by short, mild winters and warm, dry summers. Long-term annual precipitation near the coast averages about 46 cm, of which 90% occurs between November and April. Sea breezes are caused by differential heating between land and sea. During the summer, these breezes combine with the prevailing winds that blow out of the northwest to produce strong onshore winds. They typically start around noon and may continue through late afternoon, with speeds reaching 40 km per hour. In late fall and winter, a reverse pressure system frequently develops, causing coastal offshore winds from the southeast from November through February, typically from 1300 to 2000 hours (hr). Monthly mean air temperatures along the coast range from 8.3°C in winter to 20.6°C in summer, with the minimum dropping slightly below freezing and maximum reaching above 37°C.

### Currents

Water in the northern Pacific Ocean is driven eastward by prevailing westerly winds until it impinges on the western coast of North America where it divides to flow both north and south. The southern component is the California Current, a diffuse and meandering water mass, which generally flows to the southeast. No fixed western boundary to this current is defined, but more than 90% of the bulk water transport is within 725 km of the California coast.

South of Point Conception the California Current diverges; one branch turns northward and flows inshore of the Channel Islands as the Southern California Countercurrent. Surface speed in the countercurrent ranges from three to six meters per minute. The general flow is complicated by small eddies around the Channel Islands and fluctuates seasonally, being well developed in summer and autumn, and weak or even absent in winter and spring. Generalized surface water circulation off southern California is shown in Figure 2. Currents near the coast are strongly influenced by a combination of wind, tide and topography. When wind-driven currents are superimposed on the tidal motion, a strong diurnal component is usually apparent. Therefore, short-term observations of currents near the coast may often vary considerably in both direction and speed.

### Tides

Tides along the California coast are mixed semi-diurnal, with two unequal highs and two unequal lows during each 25-hr period. In the eastern North Pacific Ocean, the tide wave rotates in a counterclockwise direction. As a result, flood tide currents flow upcoast and ebb tide currents flow downcoast.

### Upwelling

The predominantly northwesterly winds along the California coast are responsible for large scale upwelling. From about February to October these winds induce offshore movement of surface water, which is replaced by the upwelling of deeper ocean waters near the coast. The upwelled water is colder, more saline, lower in oxygen, and higher in nutrient concentrations than surface waters. Thus, upwelling not only alters the physical properties of the surface waters, but also affects biological productivity.

## RECEIVING WATER CHARACTERISTICS

Water quality at AES Redondo Beach L.L.C. generating station is affected by hydrology, currents, storm water runoff, industrial discharges and ship traffic. In addition, climatological parameters such as solar radiation, humidity, and wind influence the condition of the receiving water.

The capacity of the marine environment to assimilate heated effluents depends on its ability to dilute and disperse the thermal discharge. The extent to which these functions are accomplished depends on the quantity and temperature of the thermal effluent relative to normal ocean temperature, ocean current patterns, and dispersion characteristics of the receiving waters. The following discussion focuses on natural ocean temperatures along the southern California coast and in Santa Monica Bay and addresses other physical and chemical oceanographic characteristics that influence the local marine biota.

### Temperature

Natural water temperatures fluctuate throughout the year in response to seasonal and diurnal variations in currents, meteorological conditions such as wind, air temperature, relative humidity, and cloud cover, and other parameters such as ocean waves and turbulence. Natural

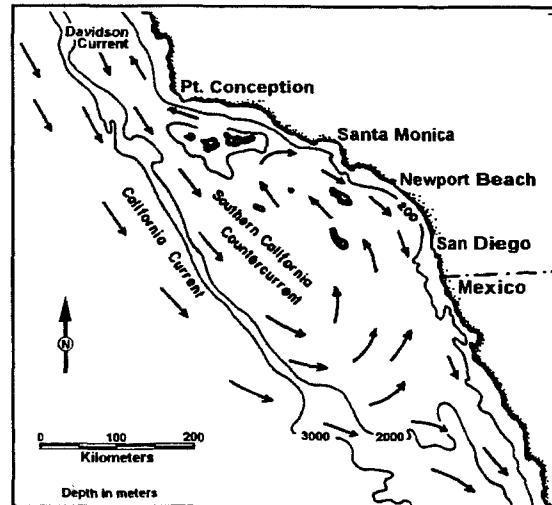


Figure 2. Surface circulation in the Southern California Bight (from Jones 1971). AES Redondo Beach L.L.C. generating station NPDES, 2001.

temperature is defined by the California State Water Resources Control Board as "the temperature of the receiving water at locations, depths, and times which represent conditions unaffected by any elevated temperature waste discharge."

Natural surface water temperatures may be expected to vary 1.0 to 2.0°C in summer and 0.3 to 1.0°C in winter on the average. Weak winds, clear skies, and warm air temperatures contribute to rapid daytime warming of the sea surface. Conversely, overcast skies, moderate air temperatures and the mixing of surface waters by winds and waves limit the daily warming. Natural surface water temperatures in Santa Monica Bay range from 11.7 to 22.2°C annually (EQA/MBC 1973).

When there is a large difference between surface and bottom water temperatures, a steep temperature gradient between adjacent water layers of different temperatures (a thermocline) may develop. Natural thermoclines are formed when absorption of solar radiation elevates the temperature of surface water, which then remains separated from the subsurface layer. Artificial thermoclines may result when warm water from a thermal discharge overlies cooler receiving waters. Off southern California, a reasonably sharp natural thermocline normally develops during the summer months in the upper 30 m of the water column; winter thermoclines are weakly defined.

### **Salinity**

Salinity is a measure of the concentration of dissolved salts and is relatively constant in the open ocean. In coastal environments it fluctuates as a result of the introduction of freshwater runoff, direct rainfall, and evaporation. Salinities in Santa Monica Bay are relatively uniform and range from 33.0 to 34.0 parts per thousand (ppt) (Allan Hancock Foundation 1965).

### **Density**

Seawater density varies inversely with temperature and directly with salinity at a given pressure. Water temperature is the major factor influencing density stratification in southern California since salinity is relatively uniform. As a result, density gradients are most pronounced when spring and summer thermoclines are present.

### **Dissolved Oxygen**

Dissolved oxygen (DO) is utilized by aquatic plants and animals in their metabolic processes. It is replenished by gaseous exchange with the atmosphere and as a by-product of photosynthesis. Concentrations in the surface waters of Santa Monica Bay, range from approximately 5 to 12 milligrams per liter (mg/l) (Allan Hancock Foundation 1965). High values can result from increased photosynthetic activity and low values result from decomposition of organic material and mixing of surface waters with oxygen-poor subsurface waters.

### **Hydrogen Ion Concentration**

The hydrogen ion concentration (pH) in the Southern California Bight varies narrowly around a mean of approximately 8.0 and decreases slightly with depth. Normal pH values in Santa Monica Bay range between 8.0 and 8.6 (Allan Hancock Foundation 1965).

## **BENEFICIAL USES OF RECEIVING WATERS**

The California Regional Water Quality Control Board (1994) enumerated 10 beneficial uses of coastal and tidal waters in the nearshore zone of the Pacific Ocean. Of these, the five that were specifically identified with the King Harbor-Redondo Beach area are as follow:

### **Industrial Service Supply**

Santa Monica Bay is used extensively as a source of cooling water for coastal generating stations and other industrial users. The King Harbor-Redondo Beach area serves as a source of cooling water for the AES Redondo Beach L.L.C. generating station.

### **Non-contact Water Recreation**

This beneficial use involves the presence of water, but does not require actual body contact with it and includes activities such as picnicking, sunbathing, hiking, beachcombing, tidepool and marine life study, camping, aesthetic enjoyment, and pleasure boating. At present, King Harbor provides berthing for approximately 1,600 boats as well as launching facilities for trailerable craft.

### **Ocean Commercial and Sport Fishing**

Commercial collection of various types of fish and shellfish, including those taken for bait purposes, and sportfishing in the ocean, bays, estuaries, and similar non-freshwater areas. King Harbor and adjacent ocean areas are used for sport fishing from pleasure boats, jetties, and piers.

### **Marine Habitat**

Biologically, Redondo Beach and King Harbor, are particularly productive and diverse, due to the variety of habitat types, nutrient-rich water from the Redondo Submarine Canyon, and thermal diversity in the area. Many resident species of fish reproduce in King Harbor and it is used as a nursery area by others.

The harbor and adjacent waters of Santa Monica Bay contribute to the preservation of a marine ecosystem by providing habitats for the propagation and sustenance of fishes and other forms of marine life.

### **Preservation of Rare and Endangered Species**

The beneficial use is the provision of an aquatic habitat necessary, at least in part, for the survival of certain species established as being rare or endangered species.

## **MATERIALS AND METHODS**

### **SCOPE OF THE MONITORING PROGRAM**

The 2001 monitoring program for the AES Redondo Beach L.L.C. generating station was conducted by MBC Applied Environmental Sciences (MBC) in accordance with specifications set forth in the NPDES Monitoring and Reporting Program (Appendix A). The monitoring program included winter and summer water column profiling, summer sediment sampling for grain size and chemistry, mussel sampling for bioaccumulation, summer biological sampling for benthic infauna, winter and summer video-cine transects for fish and macroinvertebrates, and periodic impingement sampling of fish and macroinvertebrates.

### **STATION LOCATIONS**

The locations of the monitoring stations are described in Appendix A and shown on Figures 3 and 4. The 2001 monitoring program included 16 water quality (RW) stations, seven sediment and benthic infauna (B) stations, two mussel stations, and three video-cine (C) transects.

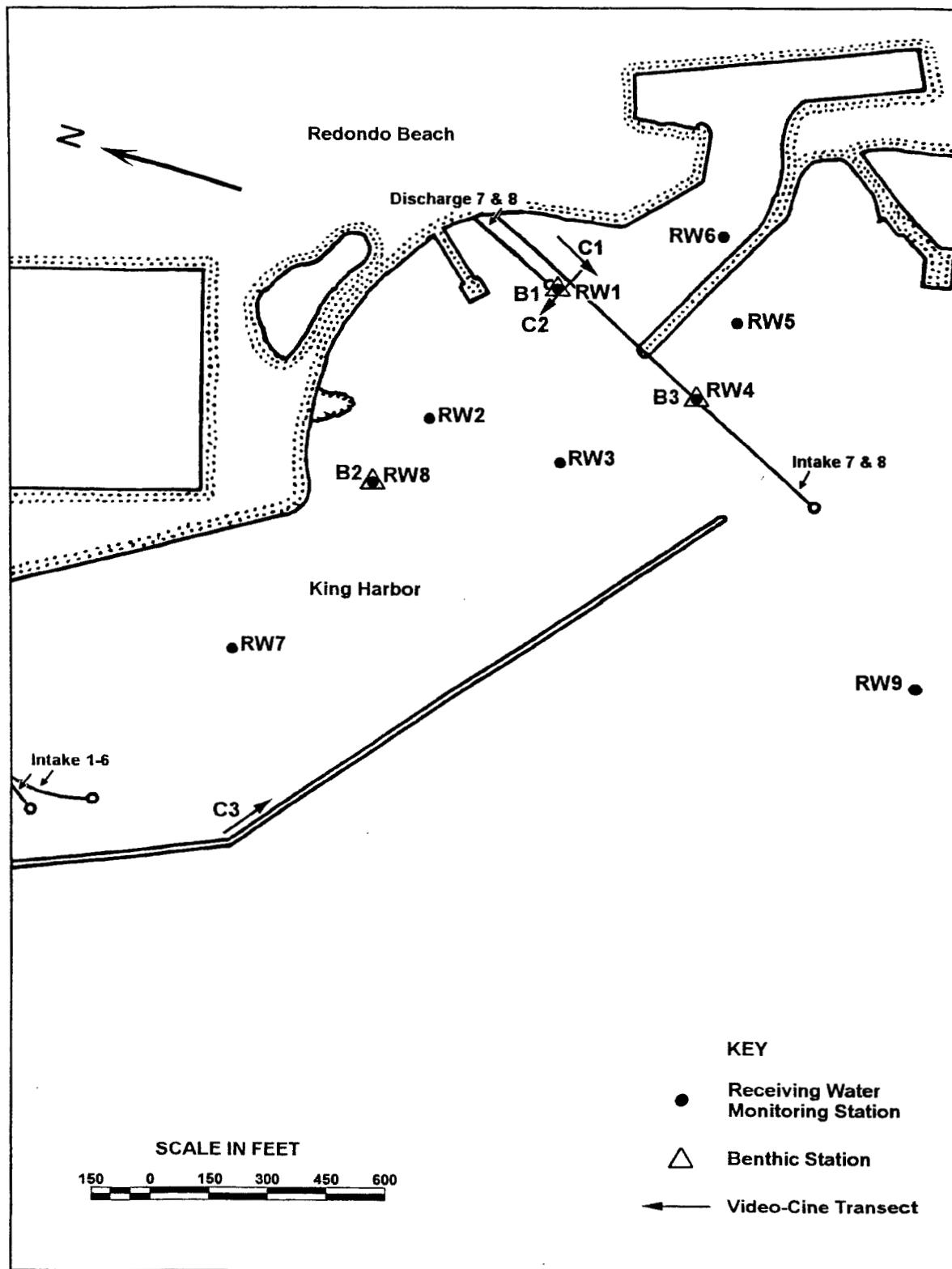


Figure 3. Location of the monitoring stations in King Harbor. AES Redondo Beach L.L.C. generating station NPDES, 2001.

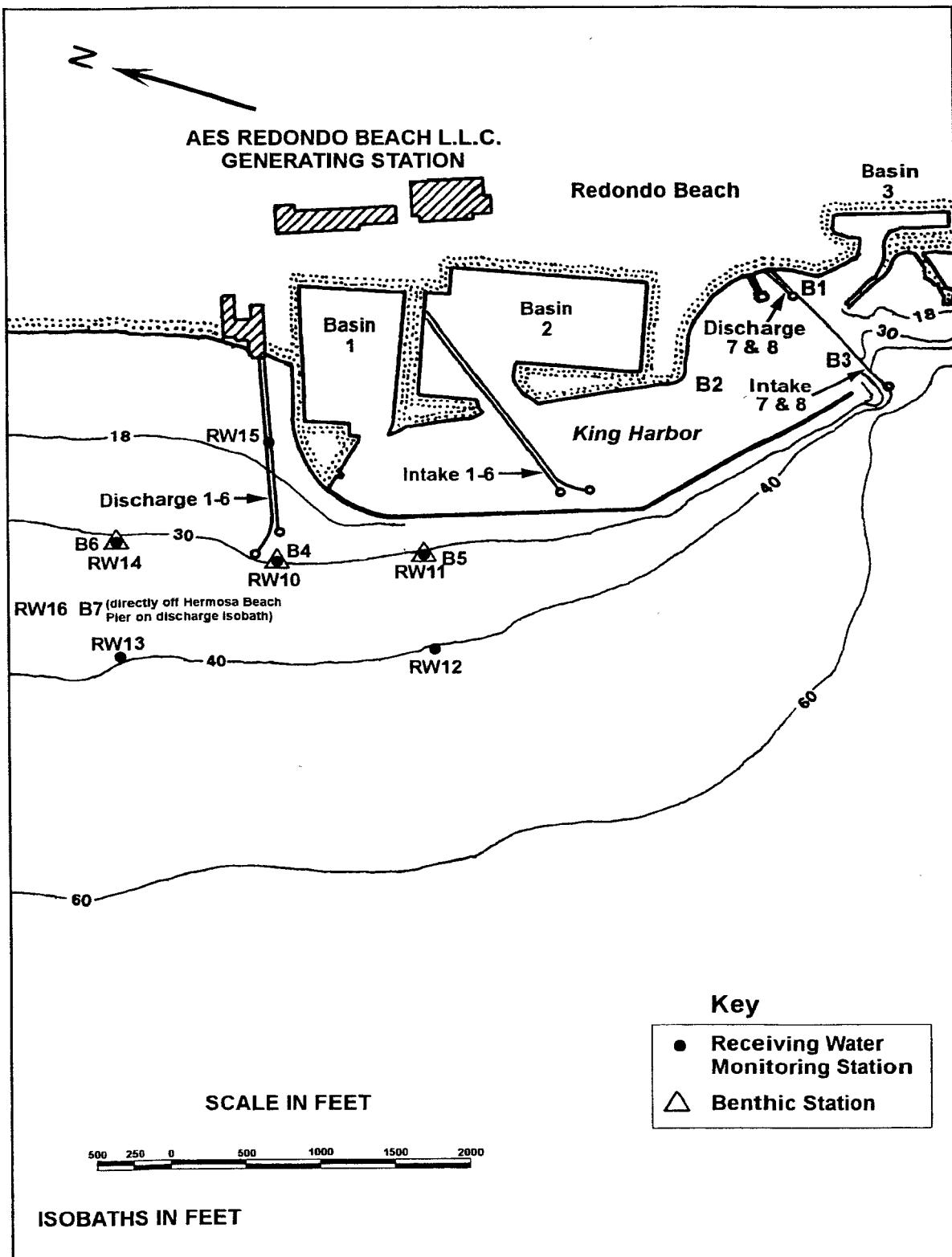


Figure 4. Location of the monitoring stations in Santa Monica Bay. AES Redondo Beach L.L.C. generating station NPDES, 2001.

## WATER COLUMN MONITORING

Temperature (°C), dissolved oxygen (DO), hydrogen ion concentration (pH), and salinity (ppt) were continuously measured throughout the water column during the winter and summer surveys. Sampling was conducted on both flood and ebb tides at each of the 12 receiving water monitoring stations (Figure 3). Data were obtained *in situ* using an SBE 9/17 CTD water quality profiling system (Sea-Bird), and averaged at 1.0 m intervals. In the field, the data were transferred from the Sea-Bird to floppy disk for storage. In the laboratory, data were processed using Sea-Bird proprietary software (SeaSoft ver. 4.21). The resulting information was imported into Microsoft Excel spreadsheets for further reduction and analysis.

## SEDIMENT MONITORING

Sediment samples were collected by biologist-divers at seven stations (Stations B1 - B7). A 15-cm-long, 3.5-cm-diameter plastic core tube was used to collect sediment for grain size analyses, and a glass jar was used to collect sediment for metal chemistry. Sediment samples were collected simultaneously with infaunal samples.

### Grain Size

The size distributions of sediment particles were determined using two techniques: laser light diffraction to measure the amount and patterns of light scattered by a particle's surface for the sand/silt/clay fraction, and standard sieving for the gravel fraction. Laboratory data from the two methods were combined and presented in tabular format. Resulting analyses include mean and median grain size, standard deviation of the grain size, sorting, skewness, and kurtosis. Data were plotted as size-distribution curves. Additional details are provided in Appendix B.

### Sediment Chemistry

Sediment collected in glass jars for chemical analyses were placed on ice in the field and maintained at approximately 4°C until laboratory procedures began. One replicate was taken at Stations B1 - B7. Sediments were analyzed for total percent solids and four metals; chromium, copper, nickel, and zinc. Environmental Protection Agency (EPA) method 160.3 was used in determining percent solids; EPA method 6010 was used for metal analysis.

## MUSSEL BIOACCUMULATION

Two sets of 45 bay mussels (*Mytilus edulis*) were collected by biologist-divers for bioaccumulation monitoring. One set each was collected from the Units 7&8 discharge buoy and from the Manhattan Beach Pier. Shell lengths ranged from 50 to 66 millimeters (mm) and averaged 54 mm at the Santa Monica Beach Pier, and ranged from 48 to 67 mm and averaged 58 mm at Units 7&8. They were processed according to methods used in the California Mussel Watch (Appendix A and SWRCB 1986). Soft tissue from the mussels was analyzed for copper, chromium, nickel, and zinc. Results were compared to levels found at the pier reference site and to other mussel watch program data that was collected and analyzed concurrently for another NPDES monitoring program.

## BIOLOGICAL MONITORING

The biological monitoring program consisted of infauna sampling by diver-operated box corers at four stations; recording of fish and macroinvertebrate populations by video-cameras along three transects; and analysis of fish impingement normal and heat treatment operational data.

### Benthic Infauna

Benthic infaunal sampling was conducted at seven benthic stations (Stations B1 - B7) (Figures 3 and 4). At each station, four replicate cores were collected using hand-held, diver-operated box corers (Figure 5). This sampling device collects a uniform sample of 10 cm x 10 cm x 10 cm for a total sample volume of 1.0 liter. The box corer is pushed into the sediments and a closing blade is swung across the mouth of the box. The core is then withdrawn from the sediments and sealed by a neoprene lid for transport to the surface.

Samples were washed in the field using a 0.5 mm stainless steel mesh screen, labeled, and fixed in buffered 10% formalin-seawater. In the laboratory, samples were re-screened through a 0.25 mm sieve, transferred to 70% isopropyl alcohol, sorted to major taxonomic groups, identified to the lowest practical taxonomic level, and counted. Representative specimens were added to MBC's reference collection.

Following identification, the weight of organisms per major taxonomic group in each replicate was obtained. Specimens were placed on small, pre-weighed mesh screens, which had been submersed in 70% isopropyl alcohol, blotted on a paper towel, and air-dried for five minutes. Total wet weight minus screen tare weight provided the wet weight of the organisms. Large organisms were weighed separately.

### Fish and Macroinvertebrates

#### Video-cine Transects

Locations of the video-cine transect stations (Stations C1, C2, and C3) are shown in Figure 3. Replicated videos of the fish and macroinvertebrate populations were taken at the three stations using standard SCUBA gear, an underwater compass, depth gauges, a Secchi disc, a 50-m transect line marked at one meter intervals, and an underwater video-camera.

At each of the three video-cine transect stations, a 50-m transect line was placed on the bottom. Biologist-divers proceeded along the transect and video-taped everything to the limits of visibility to each side and above the transect line. Biologist-divers reversed their direction and proceeded back along the transect line to replicate their observations. Underwater visibility was estimated using a standard Secchi disc. One diver swam along the transect with the disc facing the stationary diver until it could no longer be seen. Video tapes were reviewed in the laboratory where all fish and macroinvertebrates were identified and counted. The two replicate transects along each video-cine transect were summed together. Results were standardized by reporting all individuals as counts per transect.

As visibility varied considerably between surveys and years, data were corrected by dividing the total fish per transect by the visibility in meters. Abundances of water column fish were recalculated to the number of fish expected with 10 m of visibility, the limit of correct identification with the video system.

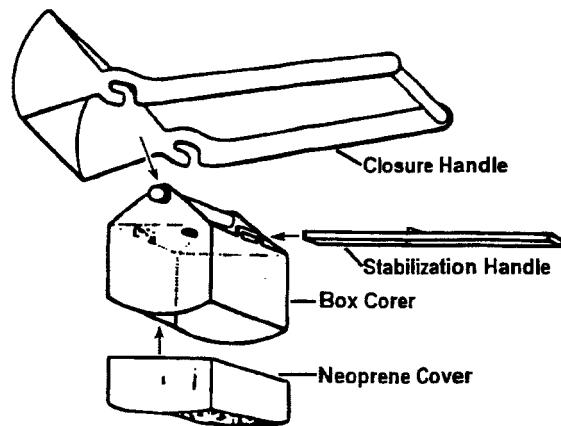


Figure 5. Diver-operated box corer used to collect infaunal samples. AES Redondo Beach L.L.C. generating station NPDES, 2001.

### Fish Impingement

Fish impingement sampling is conducted during representative periods of normal operation and during all heat treatment procedures to obtain an estimate of total impingement for the year. A normal operation survey is defined as a sample of all fish and macroinvertebrates entrained by water flow into the generating station intake and subsequently impinged onto traveling screens during a 24-hr period with all circulating pumps operating, if possible. Not all fish and macroinvertebrates entrained each day are impinged, resulting in a residual resident population in the screenwells and tunnels. The number of operational days is usually less than 365 because of plant maintenance downtime and seasonal fluctuations in the demand for electricity, which may result in decreased water flow into the power plant. Normal operation abundance and biomass for the year are estimated by extrapolating the monitored abundance and biomass based on the percentage of the annual flow into the plant on the days sampled. Exceptions to this method are made where such extrapolations would result in exaggerated counts for species that typically occur in low abundance.

A heat treatment is an operational procedure designed to eliminate mussels, barnacles, and other fouling organisms, which grow in and occlude the generating station conduits. During a heat treatment, heated effluent water from the discharge conduit is re-entrained via cross-connecting tunnels to the intake conduit until the water temperature rises to approximately 40.5°C. This temperature is maintained for a period of at least one hour during which time all mussels, barnacles, and residual resident fish and invertebrates living within the intake conduit and forebay succumb to the heated water. All material is subsequently impinged onto the traveling screens and removed from the forebay. The fish and macroinvertebrates are then separated from incidental debris, sorted by species, identified, and counted. Fish are measured in millimeters to either standard length (SL), total length, (TL) or disc width (DW), as appropriate, and examined for external parasites, anatomical anomalies, and other abnormalities. Aggregate weights are taken by species for both fish and macroinvertebrates. Unusual specimens and those of uncertain identity are preserved in 10% formalin-seawater and returned to the laboratory for positive species determination and, if warranted, retention in the MBC collection of voucher species. Data are collected for each heat treatment survey and combined with the estimated normal operation data to determine the total impingement loss for the year.

### STATISTICAL ANALYSES

Summary statistics developed from the biological data included the number of individuals (expressed as both number per grab and density), number of species and Shannon-Wiener (Shannon and Weaver 1962) species diversity ( $H'$ ) index.

The diversity equation is as follows:

Shannon-Wiener

$$H' = - \sum_{j=1}^S \frac{n_j}{N} \ln \frac{n_j}{N}$$

where:  $H'$  = species diversity  
 $n_j$  = number of individuals in the  $j^{\text{th}}$  species  
 $S$  = total number of species  
 $N$  = number of individuals

Data from infaunal coring collections were subjected to log transformations (when necessary) and classified (clustered) using the SYSTAT (SYSTAT ver. 5.0, Systat, Inc., Evanston, IL) clustering module (Wilkinson 1986). Cluster analysis provides a graphic representation of the

relationship between species, their individual abundance, and spatial occurrence among the stations sampled. In theory, if physical conditions were identical at all stations, the biological community would be expected to be identical as well. In practice this is never the case, but it is expected that the characteristics of adjacent stations would be more similar than those distant from one another. The dendrogram shows graphically the degree of similarity (and dissimilarity) between observed characteristics and the expected average. The two-way analysis utilized in this study illustrates groupings of species and stations, as well as their relative abundance, expressed as a percent of the overall mean. Two classification analyses are performed on each set; in one (normal analysis) the sites are grouped on the basis of the species which occurred in each, and in the other (inverse analysis) the species are grouped according to their distribution among the sites. Each analysis involves three steps. The first is the calculation of an inter-entity distance (dissimilarity) matrix using Euclidean distance (Clifford and Stephenson 1975) as the measure of dissimilarity, where:

Clifford and Stephenson

$$D = \left[ \sum_{1}^{n} (x_1 - x_2) \right]^{1/2}$$

D = Euclidean distance between two entities  
 $x_1$  = score for one entity  
 $x_2$  = score for other entity  
n = number of attributes

The second procedure, referred to as sorting, clusters the entities into a dendrogram based on their dissimilarity. The group average sorting strategy was used in construction of the dendrogram (Boesch 1977). In step three, the dendograms from both the site and species classifications are combined into a two-way coincidence table. The relative abundance values of each species are replaced by symbols (Smith 1976) and entered into the table. In the event of extreme high abundance of a single species, abundance data are transformed using a natural log transformation [ $\ln(x)$ ].

#### DETECTION LIMITS

Detection limits (DL) used in reporting chemistry results are interpreted as the smallest amount of a given analyte that can be measured above the random noise inherent in any analytical tool. Thus, any value below the DL cannot be considered a reliable estimate of analyte concentration. Therefore, where a test for a given analyte results in a level below the DL, a "none detected" (ND) value has been assigned. The complication of what numerical value to substitute for ND in statistical calculations is addressed by EPA (1989, Section 5.3.3). When values for a given analyte are ND for all stations, then means and standard deviations will also be considered ND. However, when an analyte is detected at some stations and not at others, statistical calculations can be made by substituting ND values with either (a) zero, (b) one-half the average detection limit, or (c) the average detection limit (EPA 1989). Determining which substitution to use is based on whether or not substantial information exists to support the historical presence or absence of a given analyte at the station location. Since chemistry analyses have repeatedly resulted in ND values at the same stations through past surveys, ND values have been replaced with zeros in performing statistical calculations in this report. This decision is also based on the fact that detection limits differ in virtually all past surveys, which would confound any yearly comparison if options (b) or (c), from above, are used. Historical raw data are presented in the appendices for possible supplementary study.

## RESULTS

### FIELD OPERATIONS

Field operations for the AES Redondo Beach L.L.C. generating station NPDES monitoring program were conducted 19 March, 20 April, 27 June, 19 September, and 3 October 2001. Latitude and longitude coordinates for all receiving water (RW) and benthos (B) stations are listed in Table 1.

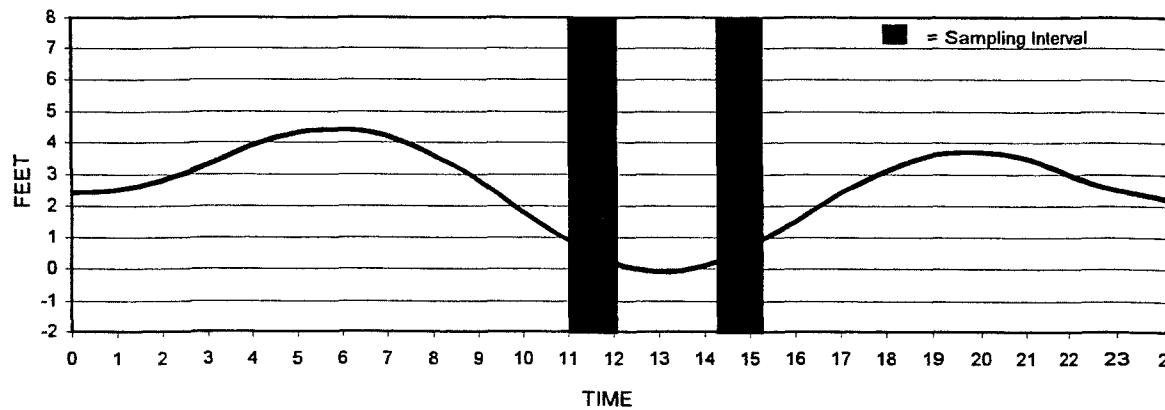
**Table 1. Latitude/longitude coordinates of sampling stations. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Stations			
Water Quality	Benthic	Latitude	Longitude
RW1	B1	33°50.55'	118°23.64'
RW2	-	33°50.60'	118°23.76'
RW3	B3	33°50.55'	118°23.70'
RW4	-	33°50.50'	118°23.67'
RW5	-	33°50.48'	118°23.62'
RW6	-	33°50.51'	118°23.57'
RW7	-	33°50.66'	118°23.88'
RW8	B2	33°50.63'	118°23.85'
RW9	-	33°50.37'	118°23.77'
RW10	B4	33°50.95'	118°24.23'
RW11	B5	33°50.83'	118°24.15'
RW12	-	33°50.78'	118°24.23'
RW13	-	33°51.06'	118°24.42'
RW14	B6	33°51.10'	118°24.26'
RW15	-	33°51.02'	118°24.10'
RW16	B7	33°51.58'	118°24.45'

Winter water quality data were collected on 19 March at Stations RW1 through RW16 during two tidal periods. Ebb tide sampling occurred between 1100 and 1230 hours (hr), and flood tide sampling occurred between 1350 and 1520 hr (Figure 6). The tide changed from a high of +4.4 ft Mean Lower Low Water (MLLW) at 0555 hr to a low of -0.1 ft MLLW at 1306 hr, and back to a high of +3.7 ft MLLW at 1948 hr. Skies were partly cloudy throughout the day. Winds changed from west at 1 to 3 kn to south at 5 kn. Seas were flat in King Harbor, with a 1- to 2-ft southwest to west swell present at the offshore stations.

On 20 April, biologist-divers video-recorded fish and macroinvertebrates along video-cine transects at Stations C1, C2, and C3. Underwater visibility was 8 to 10 m. Skies were clear with the

wind west at 5 to 10 kn. Visibility in the harbor in March was less than three meters, inadequate for the video survey.



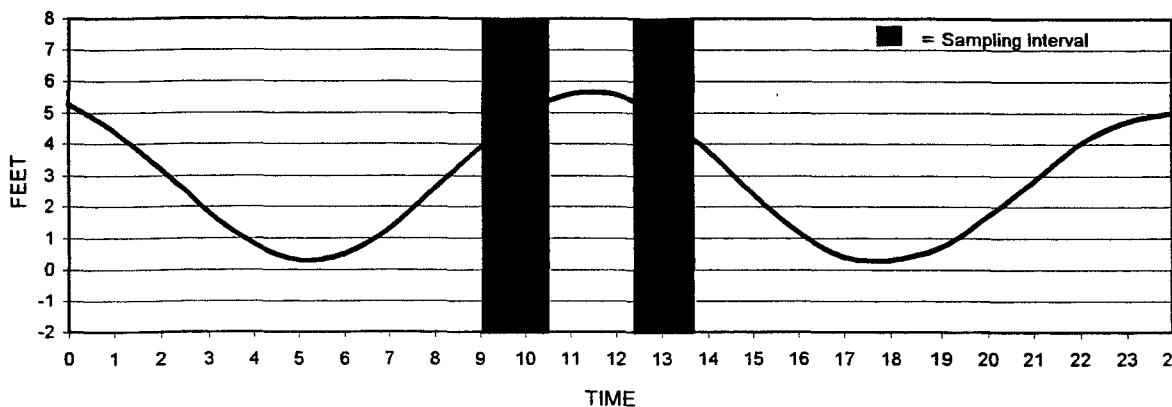
Pacific Standard Time		Monday		March 19, 2001	
Time	Height	Time	Height	Time	Height
0008	2.4'	0555	4.4'	1306	-0.1'
					1948
					3.7'

**Figure 6. Tidal rhythms during water column sampling, winter survey. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

On 27 June, between 0940 and 1445 hr, biologist-divers collected sediment cores at Stations B1 through B7 for infauna, sediment grain size, and chemical analyses. Skies changed from

partly cloudy to clear in the afternoon. Winds were from the southwest at 5 to 15 kn throughout the day, with seas in the offshore from the southwest at 1- to 3-ft, and flat in King Harbor.

Summer water quality data were collected on 19 September at Stations RW1 through RW16 during two tidal periods. Flood tide sampling occurred between 0900 and 1040 hr, and ebb tide sampling occurred between 1220 and 1350 hr (Figure 7). The tide changed from a low of +0.3 ft Mean Lower Low Water at 0514 hr to a high of +5.7 ft MLLW at 1127 hr, and back to a low of +0.3 ft MLLW at 1747 hr. Skies changed from overcast to mostly cloudy, with winds less than 5 kn from the south to southwest. Seas were flat in King Harbor, with a 2-ft west-southwest swell present at the offshore stations.



Pacific Daylight Time		Wednesday		September 19, 2001	
Time	Height	Time	Height	Time	Height
0514	0.3'	1127	5.7'	1747	0.3'
					2356
					5.0'

Figure 7. Tidal rhythms during water column sampling, summer survey. AES Redondo Beach L.L.C. generating station NPDES, 2001.

On 3 October, biologist-divers video-recorded fish and macroinvertebrates along video-cine transects at Stations C1, C2, and C3. Underwater visibility was 6 to 10 m. Skies were clear and the wind was from the west at 2 to 8 kn.

During the winter survey no oil or grease, red tide (plankton bloom), or turbidity was seen. Drift kelp (*Macrocystis pyrifera*) was seen at Stations RW9, RW13 and RW15; wood, paper, or plastic trash was seen at Stations RW12, RW13, and RW15; and surface foam was seen along the breakwater at Station RW9. Western gulls (*Larus occidentalis*) and Brandt's cormorants (*Phalacrocorax penicillatus*) were seen at most of the stations inside King Harbor, and at offshore stations a western gull was seen at Stations RW11 and RW16. Less abundant bird species noted were: Caspian terns (*Sterna caspia*) at Stations RW13 and RW14; Heermann's gulls (*Larus heermanni*) at Stations RW7, RW8, and RW12; and willets (*Catoptrophorus semipalmatus*) at Station RW6. A bottlenose dolphin (*Tursiops truncatus*) was seen at Station RW10, and California sea lions (*Zalophus californianus*) were seen on the buoy at Station RW9, and swimming at Stations RW2 and RW8. California brown pelicans (*Pelecanus occidentalis californicus*) were seen at most stations inside King Harbor; no California brown pelicans were seen at the offshore stations. No California least terns (*Sterna antillarum browni*) were seen during the winter survey.

During the summer surveys, no oil or grease, or red tide were seen at sampling stations. A large area of red tide was noted offshore of the work area on 27 June. The water was slightly turbid at Stations B4, B5, and B6; drift algae was noted at Stations RW7, RW9, RW13, RW14, and RW15.

Western gulls and Heermann's gulls were seen throughout the study area during water quality sampling, and at Stations B3 and B4 on 27 June. Other, less common, bird species seen were: unidentified cormorants (*Phalacrocorax* sp.) at Stations RW4, RW5, and RW6; Brandt's cormorants at Stations B1 and B3; a willet at Station RW14; an unidentified tern (*Sterna* sp.) at Station RW10; and a great blue heron (*Ardea herodias*) at Station RW6. California sea lions were present on the bell buoy at Station RW9, and swimming at Station B4. California brown pelicans were observed throughout the study area during water quality and at stations inside King Harbor during benthic sampling. No California least terns were seen during the summer surveys.

## WATER COLUMN MONITORING

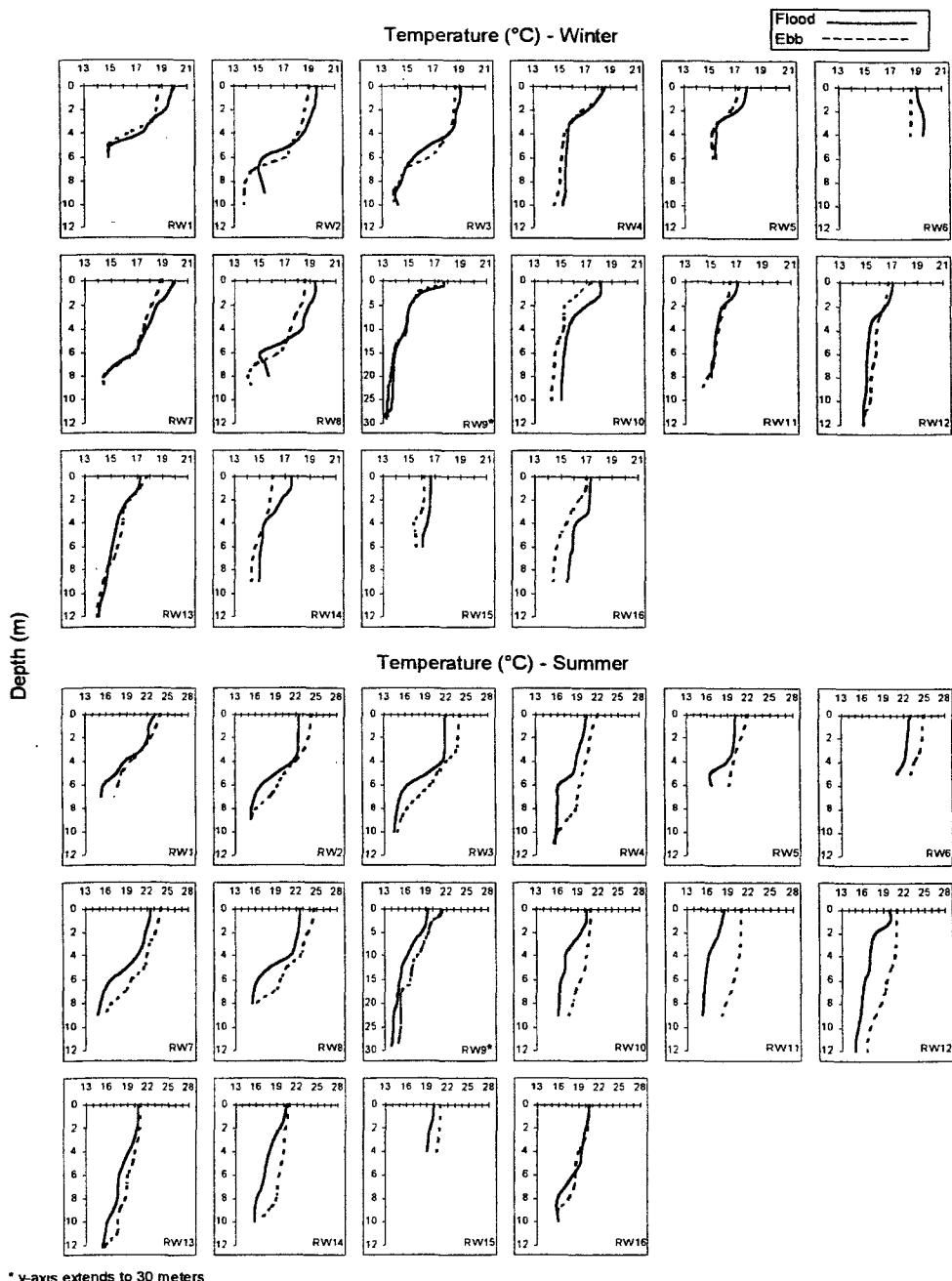
Water quality data for winter and summer surveys during ebb and flood tides are provided in Figures 8 through 11 and are summarized in Tables 2 and 3; raw data are presented in Appendix C. Two distinct water quality regimes were sampled; King Harbor (the receiving waters for Units 7&8) and the waters surrounding King Harbor in nearshore Santa Monica Bay (the receiving waters for Units 5&6). Stations RW1 through RW8 are located inside King Harbor; Stations RW9 through RW16 are located outside the harbor. Station RW9 is at the head of the Redondo Submarine Canyon, where water depth is more than twice that at all other stations.

### Temperature

During the winter survey, ebb tide water quality was sampled during the late morning and flood tide was sampled in the afternoon. Surface temperatures in King Harbor averaged 18.55°C during ebb tide and ranged from 17.37°C at Station RW5 to 18.99°C at Station RW2 (Table 2). During flood tide, surface temperatures in the harbor averaged 19.16°C and ranged from 17.91°C at Station RW5 to 19.92°C at Station RW7. Surface temperatures in the harbor were slightly higher (most by less than 1°C) during flood tide than during the morning ebb tide. Nonetheless, temperature profiles were nearly identical between tides at all stations (Figure 8). Thermoclines (changes in water temperature 1°C or greater per one meter depth increase) were recorded at most harbor stations at varying depths during both tides, except at Station RW6, the shallowest station, where waters were relatively isothermal from surface to bottom. The average near-bottom temperature during ebb tide was 14.98°C, with temperatures ranging from 13.84°C at Station RW2 to 18.48°C at Station RW6. The average near-bottom temperature during flood tide was 15.60°C with temperatures ranging from 14.20°C at Station RW3 to 19.46°C at Station RW6. The greatest surface-to-bottom temperature differentials were recorded at Station RW2 (5.15°C) during ebb tide and at Station RW7 (5.45°C) during flood tide.

**Table 2. Summary of water quality parameters during ebb and flood tides at King Harbor, Stations RW1 through RW8. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

	Temp. (°C)	D.O. (mg/l)	pH	Salinity (ppt)		Temp. (°C)	D.O. (mg/l)	pH	Salinity (ppt)
Winter									
Surface					Bottom				
Mean	18.55	19.16	7.11	7.57	8.00	8.06	33.21	33.11	14.98 15.60 7.68 8.31 8.04 8.11 33.32 33.37
Minimum	17.37	17.91	6.41	6.89	7.94	8.01	32.83	32.58	13.84 14.20 6.73 7.59 7.96 8.00 33.13 33.12
Maximum	18.99	19.92	7.63	8.05	8.04	8.12	33.29	33.24	18.48 19.46 8.69 9.15 8.15 8.19 33.60 33.89
Summer									
Surface					Bottom				
Mean	23.71	21.96	6.52	6.26	7.91	7.89	33.52	33.44	17.05 15.79 7.11 6.99 7.95 7.92 33.55 33.61
Minimum	21.87	20.11	6.37	5.90	7.90	7.88	33.48	33.07	14.79 14.35 6.55 6.49 7.90 7.90 33.41 33.49
Maximum	24.78	23.17	6.68	6.54	7.92	7.90	33.60	33.56	23.04 19.34 7.32 7.24 8.01 7.94 33.67 34.05



**Figure 8. Temperature vertical profiles during ebb and flood tides. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

In Santa Monica Bay, the mean surface water temperature during winter averaged 16.90°C on ebb tide, with values ranging from 16.08°C at Station RW14 to 17.83°C at Station RW13, both located downcoast from the Units 5&6 discharge (Table 3). Surface temperatures during flood tide were slightly higher than temperatures recorded during ebb tide, except at Station RW13. Temperature profiles were nearly identical between tides at all stations (Figure 8). During flood tide, the mean surface temperature was 17.35°C, with values ranging from 16.68°C at Station RW15 to

18.12°C at Station RW10, located at the discharge for Units 5&6. Thermoclines were recorded at several stations in Santa Monica Bay, and the water column was more stratified during flood tide than during ebb tide. The magnitude and depth of the thermoclines varied among stations. Near-bottom temperatures during ebb tide sampling averaged 14.39°C and ranged from 13.39°C at Station RW9, the deepest station, to 15.56°C at Station RW15. During flood tide, near-bottom temperatures averaged 14.82°C and ranged from 13.19°C at Station RW9 to 16.03°C at Station RW15. The maximum surface-to-bottom temperature differentials were recorded at Station RW9; 3.96°C on ebb tide and 4.50°C during flood tide.

**Table 3. Summary of water quality parameters during ebb and flood tides at Santa Monica Bay, Stations RW9 through RW16. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

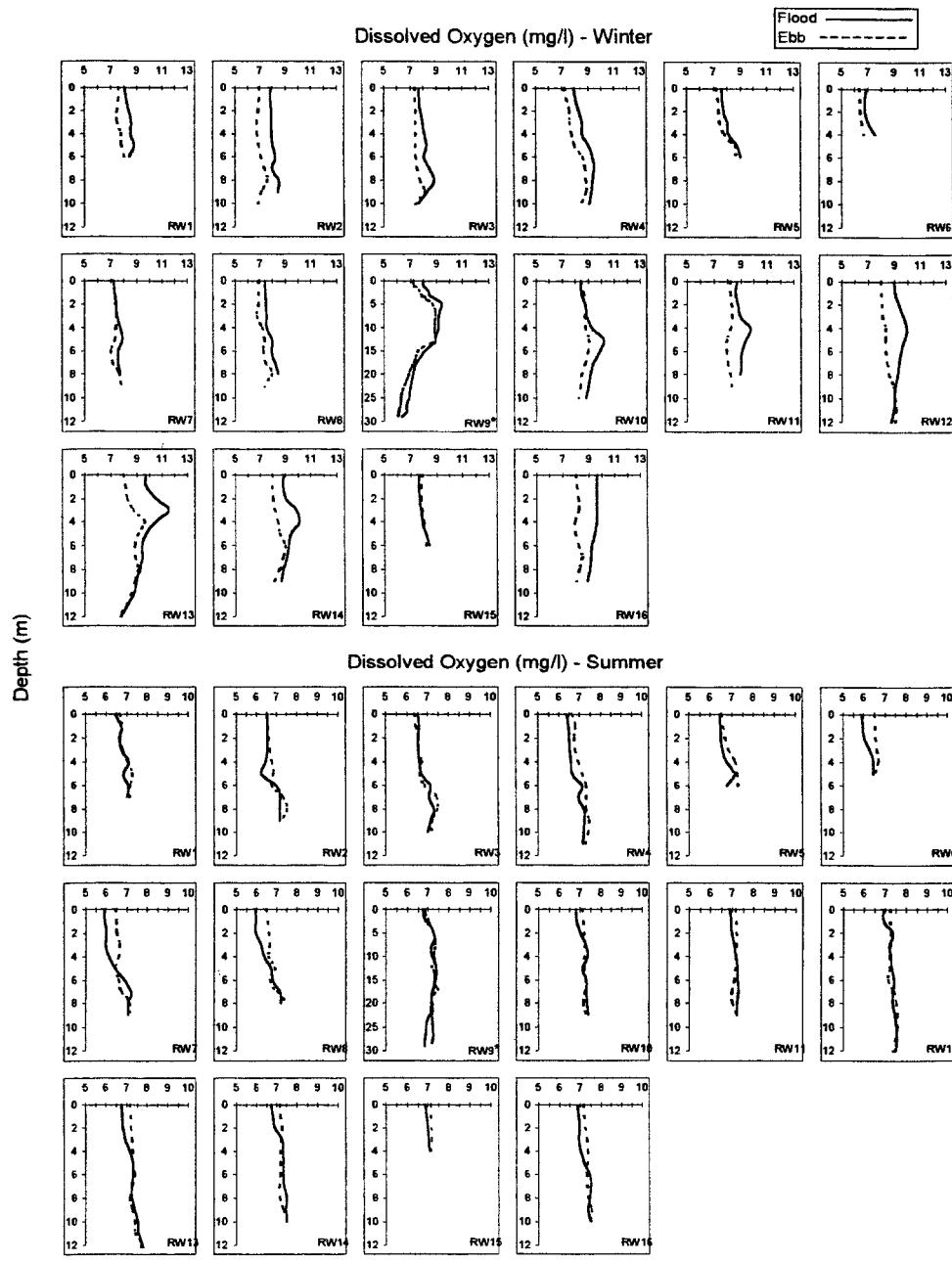
	Temp. (°C)				D.O. (mg/l)				pH				Salinity (ppt)					Temp. (°C)				D.O. (mg/l)				pH				Salinity (ppt)																											
Winter																																																									
Surface																																																									
Mean	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood																											
Mean	16.90	17.35	7.98	8.73	8.11	8.17	33.20	33.21	14.39	14.82	7.99	8.32	8.06	8.10	33.29	33.26	16.08	16.68	7.23	7.64	8.03	8.10	33.10	33.15	13.39	13.19	6.07	6.30	7.92	7.89	33.20	33.21																									
Minimum	16.08	16.68	7.23	7.64	8.03	8.10	33.10	33.15	14.39	14.82	7.99	8.32	8.06	8.10	33.29	33.26	17.83	18.12	8.43	9.70	8.14	8.26	33.26	33.25	15.56	16.03	9.07	8.96	8.13	8.18	33.35	33.39																									
Maximum	20.90	19.92	7.14	6.83	8.00	7.97	33.58	33.54	17.05	15.61	7.36	7.37	7.96	7.93	33.54	33.50	20.52	18.49	6.88	6.73	7.94	7.91	33.55	33.48	14.86	13.92	7.16	6.78	7.89	7.86	33.42	33.43																									
Maximum	21.29	20.50	7.25	6.91	8.02	7.99	33.60	33.59	20.46	18.14	7.55	7.72	7.99	7.96	33.62	33.55																																									
Summer																																																									
Surface																																																									
Mean	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood																											
Mean	20.90	19.92	7.14	6.83	8.00	7.97	33.58	33.54	17.05	15.61	7.36	7.37	7.96	7.93	33.54	33.50	20.52	18.49	6.88	6.73	7.94	7.91	33.55	33.48	14.86	13.92	7.16	6.78	7.89	7.86	33.42	33.43																									
Minimum	20.52	18.49	6.88	6.73	7.94	7.91	33.55	33.48	14.86	13.92	7.16	6.78	7.89	7.86	33.42	33.43	21.29	20.50	7.25	6.91	8.02	7.99	33.60	33.59	20.46	18.14	7.55	7.72	7.99	7.96	33.62	33.55																									

During the summer survey, flood tide water quality was sampled during the morning and ebb tide was sampled in the afternoon. Surface temperatures in King Harbor averaged 21.96°C during flood tide and ranged from 20.11°C at Station RW5 to 23.17°C at Station RW1, located at the discharge for Units 7&8 (Table 2). During ebb tide, surface temperatures in the harbor averaged 23.71°C and ranged from 21.87°C at Station RW5 to 24.78°C at Station RW6. Surface temperatures in King Harbor were 0.7 to 2.2°C warmer during ebb tide than during flood tide. However, temperature profiles were similar between tides (Figure 8). Thermoclines were recorded at all stations during both tides, except at Stations RW5 and RW6 during ebb tide. The magnitude and depth of the thermoclines varied among stations. During flood tide, the average near-bottom temperature was 15.79°C with temperatures ranging from 14.35°C at Station RW3 to 19.34°C at Station RW6. The average near-bottom temperature during ebb tide was 17.05°C, with values ranging from 14.79°C at Station RW3 to 23.04°C at Station RW6. The greatest surface-to-bottom differentials were recorded at Station RW1 (8.24°C) on flood tide and Station RW2 (9.52°C) on ebb tide.

Surface water temperatures in summer at Santa Monica Bay stations averaged 19.92°C on flood tide, with values ranging from 18.49°C at Station RW11 to 20.50°C at Station RW13 (Table 3). During ebb tide, surface temperatures were 0.2 to 2.0°C higher than those recorded during flood tide, averaging 20.90°C and ranging from 20.52°C at Station RW16, located 4,400 ft upcoast of the Units 5&6 discharge, to 21.29°C at Station RW9. On ebb tide, temperatures throughout the water column were slightly higher than during flood tide, except at Station RW16, where temperatures at four to five meters depth were slightly higher during flood tide (Figure 8). Thermoclines were recorded at three stations during flood tide and four stations during ebb tide. Near-bottom temperatures were lowest at the deepest station, Station RW9, with surface-to-bottom temperature differentials of 5.38°C during flood tide and 6.43°C during ebb tide. Near-bottom temperatures during flood tide averaged 15.61°C and ranged from 13.92°C at Station RW9 to 18.14°C at Station RW15. During ebb tide, near-bottom temperatures averaged 17.05°C and ranged from 14.86°C at Station RW9 to 20.46°C at Station RW15.

### Dissolved Oxygen

Winter dissolved oxygen (DO) concentrations in King Harbor were fairly uniform from surface to bottom, and profiles were similar among stations and between tides (Figure 9). At all harbor stations, DO concentrations increased slightly from surface to bottom, or increased from the surface to just above bottom, then decreased. Surface DO during ebb tide averaged 7.11 mg/l and ranged from 6.41 mg/l at Station RW6 to 7.63 mg/l at Station RW1 (Table 2). During flood tide,



\* y-axis extends to 30 meters

**Figure 9. Dissolved oxygen vertical profiles during ebb and flood tides. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

surface DO concentrations averaged 7.57 mg/l and ranged from 6.89 mg/l at Station RW6 to 8.05 mg/l at Station RW1. Near-bottom DO concentrations averaged 7.68 mg/l during ebb tide and 8.31 mg/l during flood tide. The largest surface-to-bottom DO differentials were recorded at Station RW5, where DO concentrations increased 1.49 mg/l on ebb tide and 1.41 mg/l during flood tide.

Surface DO concentrations during winter at the Santa Monica Bay stations averaged 7.98 mg/l during ebb tide, ranging from 7.23 mg/l at Station RW9 to 8.43 mg/l at Station RW10 (Table 3). During flood tide, surface DO averaged 8.73 mg/l and ranged from 7.64 mg/l at Station RW15 to 9.70 at Station RW13. At most stations, DO values throughout the water column were higher during flood tide than during ebb tide (Figure 9). A plankton bloom (red tide) was visible at the surface at Station RW13 during both tides, and at Stations RW12, RW14, and RW16 during flood tide. Dissolved oxygen concentrations varied throughout the water column, with mid-water DO maxima at most stations during both tides. Near-bottom values at all stations were within 2.0 mg/l of surface values. Near-bottom DO concentrations averaged 7.99 on ebb tide and 8.32 during flood tide. The largest surface-to-bottom DO differentials were recorded at Station RW9 (1.16 mg/l) during ebb tide and at Station RW13 (1.93 mg/l) during flood tide.

In summer, DO concentrations in King Harbor fluctuated with depth, and near-bottom DO values were slightly higher than surface values at all stations during both tides (Figure 9). Dissolved oxygen concentrations were similar throughout water column at all harbor stations, ranging from 5.90 to 7.53 mg/l. During flood tide, surface DO averaged 6.26 mg/l, ranging from 5.90 mg/l at Stations RW6 and RW7 to 6.54 mg/l at Station RW3 (Table 2). Surface DO during ebb tide averaged 6.52 mg/l and ranged from 6.37 mg/l at Station RW3 to 6.68 mg/l at Station RW1. Near-bottom DO concentrations averaged 6.99 mg/l during flood tide and 7.11 mg/l during ebb tide. The largest surface-to-bottom DO differentials were recorded at Station RW8 (1.29 mg/l) during flood tide and at Station RW2 (0.78 mg/l) during ebb tide.

Surface DO concentrations during summer at the Santa Monica Bay stations averaged 6.83 mg/l during flood tide, ranging from 6.73 mg/l at Station RW9 to 6.91 mg/l at Station RW12 (Table 3). Surface concentrations were slightly higher at all stations during ebb tide than during flood tide. During ebb tide, DO concentrations averaged 7.14 mg/l, ranging from 6.88 mg/l at Station RW9 to 7.25 mg/l at Station RW12. Dissolved oxygen concentrations varied little throughout the water column, and bottom DO concentrations were within 1 mg/l of surface DO concentrations (Figure 9). Near-bottom DO averaged 7.37 mg/l during flood tide and 7.36 mg/l during ebb tide. The largest surface-to-bottom DO differentials occurred at Station RW13 (0.97 mg/l) during flood tide and at Stations RW13 and RW14 (0.36 mg/l) during ebb tide.

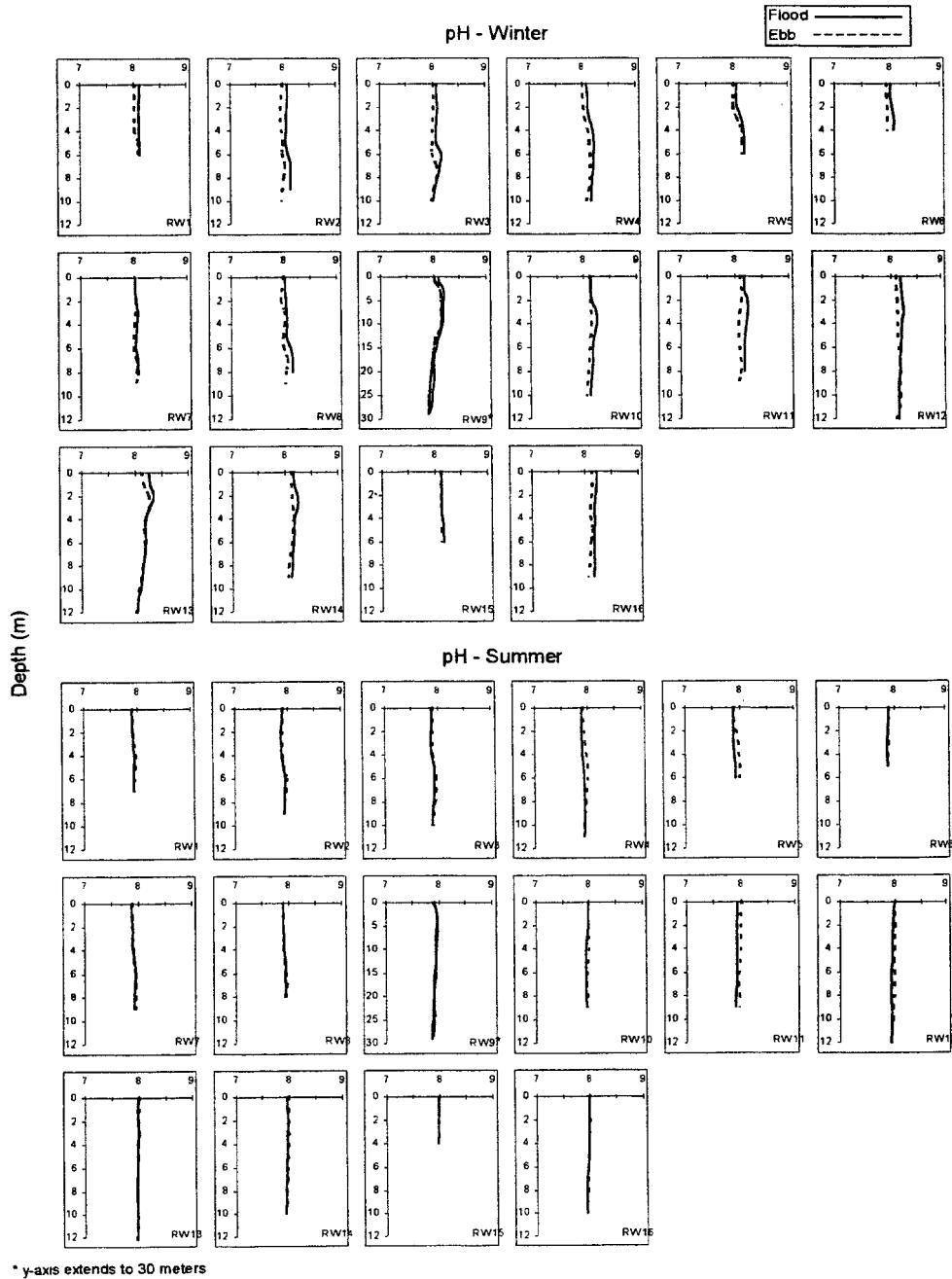
### Hydrogen Ion Concentration

Hydrogen ion (pH) values were relatively similar among stations and between surveys in 2001 (Figure 10). In winter, surface pH in King Harbor averaged 8.00 during ebb tide and 8.06 during flood tide (Table 2). In Santa Monica Bay, surface pH in winter averaged 8.11 during ebb tide and 8.17 during flood tide (Table 3). At most stations, pH increased slightly from surface to bottom, or increased from the surface to a mid-water maximum, then decreased. In summer, surface pH in King Harbor averaged 7.89 during flood tide and 7.91 during ebb tide. In Santa Monica Bay, surface pH averaged 7.97 during flood tide and 8.00 during ebb tide. Summer pH values throughout the study area were less variable than those in winter, especially in King Harbor.

### Salinity

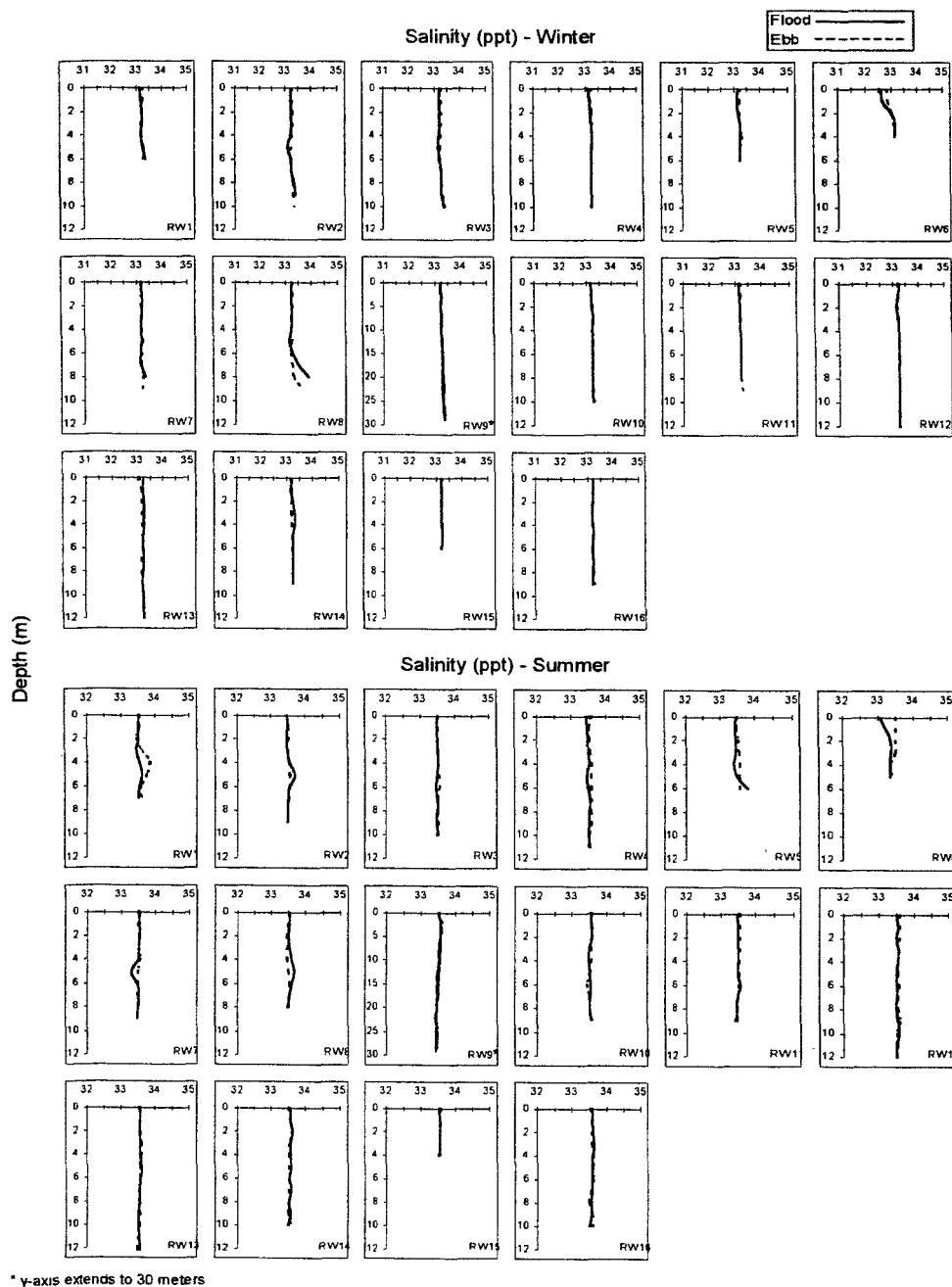
Salinity values were relatively similar among stations and between surveys in 2001 (Figure 11). In winter, surface salinity in King Harbor averaged 33.21 parts per thousand (ppt) during ebb tide and 33.11 ppt during flood tide (Table 2). In Santa Monica Bay surface salinity in winter

averaged 33.20 ppt during ebb tide and 33.21 ppt during flood tide (Table 3). At most stations during both tides, salinity varied throughout the water column, but bottom values were generally slightly higher than surface values. Salinity increased greatly near bottom at Station RW8 during both tides, and lower than average salinity values were recorded at the surface at Station RW6 during both tides.



**Figure 10. Hydrogen ion concentration (pH) vertical profiles during ebb and flood tides. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

In summer, surface salinity in King harbor averaged 33.44 ppt during flood tide and 33.52 ppt during ebb tide (Table 2). In Santa Monica Bay surface salinity in summer averaged 33.54 ppt during flood tide and 33.58 ppt during ebb tide (Table 3). Salinity profiles were near vertical at the offshore stations, though salinity was more variable in the harbor (Figure 11). Mid-water minima and maxima were recorded at several harbor stations, and salinity increased greatly near bottom at Station RW5 during flood tide.



**Figure 11. Salinity (ppt) vertical profiles during ebb and flood tides. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

## SEDIMENT MONITORING

### Sediment Grain Size

Sediment grain size distribution curves and parameters describing grain size characteristics at each station are presented in Appendix D and summarized in Table 4. Grain size is expressed in phi ( $\phi$ ) units, which are inversely related to grain diameter in millimeters (mm) (Appendix B).

Sediments in the study area in 2001 were composed primarily of sand, with smaller amounts of silt and clay (Table 4). Overall, sediments in the study area averaged 88.6% sand, 9.7% silt, and 1.6% clay. The percentage of sand was greatest at Station B3 (97.0%) located offshore of Units 7&8 discharge and least at Station B2 (51.9%), further inside King Harbor. Percentage of sand was more variable among King Harbor stations (51.9% to 97.0%) than among Santa Monica Bay stations (90.0% to 96.1%). Percentages of silt and clay were greatest at Station B2 (41.6% silt and 6.6% clay) and lowest at Station B3 (2.7% silt and no clay). Gravel was not present in any of the 2001 samples. Mean grain size averaged 2.55 phi (171  $\mu\text{m}$ ), and ranged from 1.47 phi (362  $\mu\text{m}$ , medium sand) at Station B3, inside King Harbor, to 4.06 phi (60  $\mu\text{m}$ , coarse silt, but bordering on very fine sand) at Station B2, inside King Harbor (Table 4).

**Table 4. Sediment grain size parameters. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Parameter	Station							Mean	S.D.
	B1	B2	B3	B4	B5	B6	B7		
% Gravel	0.97	0.00	0.30	0.00	0.00	0.00	0.00	0.18	0.37
% Sand	95.79	51.86	97.00	95.72	96.08	93.43	89.95	88.55	16.35
% Silt	3.24	41.55	2.70	3.55	3.04	5.13	8.60	9.69	14.20
% Clay	0.00	6.59	0.00	0.73	0.88	1.44	1.45	1.58	2.29
<b>Mean grain size</b>									
phi	1.95	4.06	1.47	2.79	2.83	3.12	3.14	2.55	0.85
$\mu\text{m}$	258	60	362	145	140	120	113	171.1	103.3
Sorting $\phi$	1.21	1.94	1.04	0.64	0.57	0.58	0.77	0.96	0.49
Skewness	-0.13	0.15	0.15	-0.02	0.07	0.03	-0.05	0.03	0.10
Kurtosis	0.95	1.38	1.00	1.22	1.12	1.22	1.63	1.22	0.23

Overall, sediments from King Harbor, Stations B1 through B3, were poorly sorted, indicating a wide range of particle sizes (Table 4). Sorting at Stations B1 through B3 ranged from 1.04 phi to 1.94 phi. At offshore Stations B4 through B7 in Santa Monica Bay, sorting values ranged from 0.57 phi to 0.77 phi. Sediments at Stations B4, B5, and B6 were moderately well sorted, and sediments from Station B7 were moderately sorted. Results indicate a narrower range of particle sizes offshore than were recorded inside the harbor.

Skewness and kurtosis tell how closely the grain size distribution curve approaches the normal Gaussian probability curve. More extreme skewness and kurtosis values indicate non-normal distributions. Skewness is a measure of the symmetry of the particle distribution curve; a value of zero indicates a symmetrical distribution of fine and coarse materials around the mode of the curve, while a value greater than zero (positive) indicates an excess of fine material, and a negative value indicates an excess of coarse material. Skewness is a measure of the symmetry of the particle distribution curve; a value of zero indicates a symmetrical curve, while a value greater than zero (positive) indicates an excess of fine material and a value less than zero (negative) indicates an excess of coarse material. Skewness at King Harbor stations ranged from -0.13 to 0.15, while skewness at offshore stations ranged from -0.05 to 0.07 (Table 4).

Kurtosis, the measure of peakedness of the particle distribution curve, ranged from 0.95 at Station B1 (at the Units 7&8 discharge) to 1.63 at Station B7 (Table 4). The kurtosis value for a normal distribution is 1.0; a value greater than 1.0 indicates a leptokurtic, or peaked, distribution with

better sorting in the central portion of the curve than in the tails, while a value less than 1.0 indicates a platykurtic, or flattened, distribution with better sorting in the tails. All station values were leptokurtic with the exception of Station B1. The range of values was generally higher at offshore Santa Monica Bay stations than King Harbor stations.

### Sediment Chemistry

Sediment samples in 2001 were evaluated for chromium, copper, nickel and zinc at all seven benthic stations. Results are presented in Appendix E, and summarized in Table 5.

The highest sediment metal concentrations for chromium (30 mg/kg) occurred at Station B2, inside the harbor, and Station B6 (19 mg/kg), outside the harbor and 1,000 ft upcoast of the Units 5&6 discharge (Table 5). Copper concentration was highest (31 mg/kg) at station B2, in the harbor at the Units 7&8 discharge. The highest concentration of nickel (30 mg/kg) occurred at Station B6. Zinc concentration was highest at Station B2 with a value of 74 mg/kg. Mean sediment metal concentrations were higher in the harbor than offshore for all metals except nickel. Concentrations of nickel and zinc were lowest at Station B3, copper at Station B1, and chromium at Station B7.

In the harbor, highest sediment metal concentrations occurred at Station B2 for chromium, copper, nickel, and zinc. Among offshore stations, highest levels of chromium, nickel, and zinc occurred at Station B6, while copper was highest at Station B5.

**Table 5. Sediment metal concentrations (mg/dry kg). AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Metal	King Harbor				Santa Monica Bay				Overall		Detection		
	B1	B2	B3	Mean	B4	B5	B6	B7	Mean	Mean	S.D.	ERL	Limit
Chromium	9.9	30	13	17.6	17	13	19	16	16.3	16.8	6.5	81	1.3-1.9
Copper	22	31	8.4	20.5	5.6	20	9.3	5.5	10.1	14.5	9.9	34	1.3-1.9
Nickel	11	16	9.9	12.3	10	12	30	12	16.0	14.4	7.2	21	1.3-1.7
Zinc	30	74	26	43.3	31	31	64	32	39.5	41.1	19.3	150	6.4-9.4

ERL = Effects Range Low

### MUSSEL BIOACCUMULATION

Bay mussels (*Mytilus edulis*) were collected near the Redondo Beach generating station Units 7&8 discharge in summer 2001 to analyze for the bioaccumulation of selected heavy metals. Bay mussels were also collected at a pier reference site upcoast of the generating station, and at Santa Catalina Island.

Copper and zinc were the only metals detected in mussel tissue from the discharge and the reference sites (Table 6). Chromium and nickel were not detected in mussel tissue at any station. Copper was found above the detection limit in only one of the three replicate samples collected at the Units 7&8 discharge in King Harbor, at a concentration of 5.6 mg/dry kg. At the pier reference site, copper was found in two of the three replicates and averaged 5.5 mg/dry kg where found. Zinc was found in all three replicates at the Units 7&8 discharge, ranging from 53 to 82 mg/dry kg with a mean concentration of 64.3 mg/dry kg. Zinc concentrations at the pier reference site ranged from 45 to 68 mg/dry kg with a mean of 53.7 mg/dry kg. Concentrations of copper and zinc at the Catalina reference site were more than three times the concentrations from King Harbor and the Manhattan Beach Pier.

**Table 6. Bay mussel tissue metal concentrations (mg/dry kg). AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Metal	Replicate			Mean	S.D.	ERL	Detection Limit
	1	2	3				
<b>Discharge</b>							
Chromium	ND	ND	ND	ND	-	81	4.6 - 4.9
Copper	ND	ND	5.6	1.9	3.2	34	4.6 - 4.9
Nickel	ND	ND	ND	ND	-	21	4.6 - 4.9
Zinc	58	82	53	64.3	15.5	150	23 - 24
<b>Pier Reference Site (Manhattan Beach Pier)</b>							
Chromium	ND	ND	ND	ND	-	81	4.5 - 5.2
Copper	ND	5.3	5.7	3.7	3.2	34	4.5 - 5.2
Nickel	ND	ND	ND	ND	-	21	4.5 - 5.2
Zinc	45	68	48	53.7	12.5	150	23 - 26
<b>Catalina (west end) Reference Site</b>							
Chromium	ND	ND	ND	ND	-	81	7.4 - 9.5
Copper	13	16	16	15	1.7	34	7.4 - 9.5
Nickel	ND	ND	ND	ND	-	21	7.4 - 9.5
Zinc	270	170	250	230	52.9	150	28 - 47

ND = Below the detection limit (for calculations ND = 0)

ERL = Effects Range Low

## BIOLOGICAL MONITORING

### Benthic Infauna

Results of the 2001 infauna analyses are presented by station and replicate in Appendix G and are summarized in Tables 7 through 9 and Figure 12.

**Species Composition.** In 2001, the infauna samples contained a total of 3,963 individuals representing 14 phyla and 252 species (or taxa) (Table 7, Appendix G-1). Annelids were the most abundant phylum (2,536 individuals, or 64% of the total), with the greatest number of species (101 species, or 40% of the total). Arthropods, mollusks, cnidarians, nemerteans, and echinoderms were next most abundant, with 12%, 10%, 5%, 4%, and 3% of the individuals, respectively. Following annelids, arthropods, mollusks, nemerteans, echinoderms, and cnidarians were next most speciose, with 28%, 18%, 4%, 4%, and 2% of the species, respectively. Annelids comprised a greater portion of the fauna at Station B2 than elsewhere in terms of abundance, although the relative number of annelid species was only slightly greater than at the other harbor stations.

**Species Richness.** Species richness (number of species) averaged 74 species per station, and ranged from 40 species at Station B4, at the Units 5&6 discharge offshore, to 139 species at Station B1, inside the harbor at the Units 7&8 discharge (Table 8). Species richness was similar between Stations B2 and B3, in King Harbor near the entrance (83 and 99 species, respectively), and somewhat lower than at Station B1. Richness was also similar among the four offshore stations, ranging from 40 to 55 species. Richness averaged 107 species per station in the harbor and less than half that, 49 species per station, offshore.

**Abundance.** Abundance averaged 566 individuals per station (142 individuals per replicate, or 14,150 individuals/m<sup>2</sup>) and ranged from 268 individuals at Station B4 to 1,391 individuals at Station B1 (Table 8). Abundance at Station B1 was almost twice that at any other station; on average, abundance in the harbor was almost three times the abundance offshore.

**Species Diversity.** Shannon-Wiener species diversity values (H') averaged 3.26 and ranged from 2.85 at Station B4 (followed closely by the value for Station B2, 2.87) to 3.64 at Station B3,

**Table 7. Number of infaunal species and individuals by phylum. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Phylum	Station							Total	Percent Total
	B1	B2	B3	B4	B5	B6	B7		
<b>Number of species</b>									
Annelida	55	42	47	21	27	20	27	101	40.08
Arthropoda	35	18	19	7	11	12	9	70	27.78
Mollusca	28	7	12	4	7	9	7	45	17.86
Nemertea	9	6	7	1	5	5	4	11	4.37
Echinodermata	5	3	4	3	1	1	1	9	3.57
Cnidaria	1	1	2	1	1	-	2	5	1.98
Phorona	2	2	1	1	1	1	1	2	0.79
Platyhelminthes	1	1	2	-	-	-	-	2	0.79
Sipuncula	1	1	1	-	-	-	-	2	0.79
Brachiopoda	-	-	1	-	-	-	-	1	0.40
Chordata	1	1	1	1	1	1	1	1	0.40
Echiura	-	-	-	-	1	-	-	1	0.40
Ectoprocta	-	-	1	-	-	-	-	1	0.40
Nematoda	1	1	1	1	-	1	-	1	0.40
Total	139	83	99	40	55	50	52	252	
<b>Number of individuals</b>									
Annelida	842	491	464	159	176	145	259	2536	63.99
Arthropoda	146	28	45	49	68	64	62	462	11.66
Mollusca	144	9	125	44	16	36	19	393	9.92
Cnidaria	136	1	6	1	29	-	8	181	4.57
Nemertea	48	25	33	1	19	9	9	144	3.63
Echinodermata	33	7	17	3	22	8	13	103	2.60
Nematoda	31	14	3	5	-	4	-	57	1.44
Chordata	3	1	1	5	10	6	4	30	0.76
Sipuncula	3	2	19	-	-	-	-	24	0.61
Phorona	4	3	5	1	2	4	3	22	0.56
Platyhelminthes	1	1	4	-	-	-	-	6	0.15
Brachiopoda	-	-	3	-	-	-	-	3	0.08
Echiura	-	-	-	-	1	-	-	1	0.03
Ectoprocta	-	-	1	-	-	-	-	1	0.03
Total	1391	582	726	268	343	276	377	3963	

near the harbor entrance (Table 8). Average value for the harbor stations was slightly greater than the average for the offshore stations.

**Biomass.** Wet weight biomass averaged 3.99 g per station (1.00 g per replicate, or 100 g/m<sup>2</sup>), and ranged from 0.74 g (18 g/m<sup>2</sup>) at Station B7 to 9.72 g (243 g/m<sup>2</sup>) at Station B1 (Table 8). Average biomass was four times greater in the harbor (6.98 g per station) than offshore (1.74 g per station). Annelids, mollusks and echinoderms contributed the most to biomass, while arthropods contributed least (among the major phyla), despite being the second most abundant phylum (Appendix G-4).

**Community Composition.** The 26 most abundant species (each of which comprised 1% or more of the abundance) together represented 66% of the total collection, but only about 10% of the species (Table 9, Appendix G-2). More than half of the top 26 species were annelids, including the most abundant species, the small polychaete *Mediomastus ambiseta*, which comprised almost 10% of the collection. Unidentified oligochaete annelids were next most abundant, at just over 8%, followed by two polychaete annelids at 5% and 4%, and unidentified cnidarians (sea anemones) at 4%. Four species of mollusks, three species of arthropods, one nematode, one echinoderm (Pacific sand dollar, *Dendraster excentricus*) and one nemertean worm were also abundant. The most abundant mollusk, California tubesnail (*Caecum californicum*), was the eighth most abundant species, and the most abundant arthropod, the amphipod *Rhepoxynius menziesi*, was eleventh in

**Table 8. Infaunal community parameters. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Parameter	Station							Total	Mean
	B1	B2	B3	B4	B5	B6	B7		
<b>Number of species</b>									
Total	139	83	99	40	55	50	52	252	74.0
Rep. Mean	65.5	36.8	49.5	19.8	31.3	26.3	27.8		36.7
Rep. S.D.	14.1	2.9	12.8	3.1	1.7	4.1	5.3		
<b>Number of individuals</b>									
Total	1391	582	726	268	343	276	377	3963	566.1
Rep. Mean	347.8	145.5	181.5	67.0	85.8	69.0	94.3		141.5
Rep. S.D.	125.6	47.7	78.4	21.5	15.1	6.7	9.4		
Density (#/m <sup>2</sup> )									14154
<b>Diversity (H')</b>									
Total	3.57	2.87	3.64	2.85	3.39	3.30	3.17	4.22	3.25
Rep. Mean	3.24	2.66	3.26	2.39	3.07	2.96	2.81		2.67
Rep. S.D.	0.31	0.34	0.21	0.17	0.09	0.16	0.29		
<b>Biomass (g)</b>									
Total	9.73	5.11	6.12	4.07	1.07	1.07	0.74	27.89	3.98
Rep. Mean	2.43	1.28	1.53	1.02	0.27	0.27	0.18		1.00
Rep. S.D.	1.40	1.05	0.31	1.38	0.08	0.16	0.07		

abundance. Seven of the top species, including the second most abundant, occurred only at the harbor stations, while an additional five species occurred primarily in the harbor. Six species occurred only at offshore stations, with six more species occurring primarily offshore. The polychaete *Apoprionospio pygmaea* was the most abundant species offshore. Only two of the top species showed no particular preference for location, and only one occurred at all seven stations.

**Table 9. The 26 most abundant infaunal species. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Phy	Species	Station							Percent Total	Cum. Percent
		B1	B2	B3	B4	B5	B6	B7		
AN	<i>Mediomastus ambiseta</i>	101	239	44	1	-	2	3	390	9.84
AN	Oligochaeta	227	17	85	-	-	-	-	329	8.30
AN	<i>Apoprionospio pygmaea</i>	1	8	-	67	25	20	74	195	4.92
AN	<i>Armandia brevis</i>	82	27	41	4	3	-	2	159	4.01
CN	Actiniaria	136	-	4	-	-	-	-	140	3.53
AN	<i>Mediomastus californiensis</i>	19	34	76	-	-	-	-	129	3.26
AN	<i>Notomastus hemipodus</i>	99	15	6	1	1	-	-	122	3.08
MO	<i>Caecum californicum</i>	34	-	78	-	-	-	-	112	2.83
AN	<i>Dorvillea (Schistomerings) annulata</i>	86	5	20	-	-	-	-	111	2.80
AN	<i>Spiophanes bombyx</i>	2	3	3	13	20	25	45	111	2.80
AR	<i>Rhepoxygnus menziesi</i>	-	-	-	15	18	15	25	73	1.84
AR	<i>Diastylopsis tenuis</i>	-	-	-	17	13	24	13	67	1.69
AN	<i>Mediomastus acutus</i>	1	1	-	16	11	20	16	65	1.64
AN	<i>Spiophanes duplex</i>	4	12	11	8	3	13	11	62	1.56
NT	Nematoda	31	14	3	5	-	4	-	57	1.44
MO	<i>Caecum crebricinctum</i>	48	-	5	-	-	-	-	53	1.34
AN	<i>Exogone lourei</i>	17	20	13	-	-	2	-	52	1.31
AN	<i>Owenia collaris</i>	1	-	3	7	41	-	-	52	1.31
AN	<i>Syllis (Typosyllis) farallonensis</i>	-	-	-	7	14	17	13	51	1.29
AR	<i>Gibberosus myersi</i>	-	-	-	13	18	11	7	49	1.24
EC	<i>Dendraster excentricus</i>	-	-	-	1	22	8	13	44	1.11
MO	<i>Tellina modesta</i>	-	-	-	4	7	24	9	44	1.11
AN	<i>Chaetozone setosa Cmplx</i>	-	1	3	12	11	6	10	43	1.09
AN	<i>Prionospio (Prionospio) heterobranchia</i>	26	6	10	-	-	-	-	42	1.06
MO	<i>Rocheffertia coeni</i>	1	-	1	36	3	-	-	41	1.03
NE	<i>Tubulanus polymorphus</i>	12	9	10	-	6	1	1	39	0.98

AN = Annelida; CN = Cnidaria; MO = Mollusca; AR = Arthropoda; NT= Nematoda; EC = Echinodermata; NE = Nemertea

**Cluster Analyses.** The 26 most abundant infauna species were used in normal (site grouping) and inverse (species grouping) classification analyses, forming two station groups and three species groups (Figure 12). Station groups were divided between harbor stations (Group I) and offshore stations (Group II). Within Group I, Stations B1 and B3 were most similar, although they clustered at a relatively high level of dissimilarity. In Group II, Stations B6 and B7 were most similar to each other, and Stations B4 and B5 were next most similar. The species groups divided between species occurring mostly in the harbor (Groups A and B) and those offshore (Group C). Species in Group A occurred at all of the harbor stations, while those in Group B were absent at harbor Station B2 or were less abundant overall. Species in Group C were more abundant offshore, with highest abundance at either Station B6 or B7.

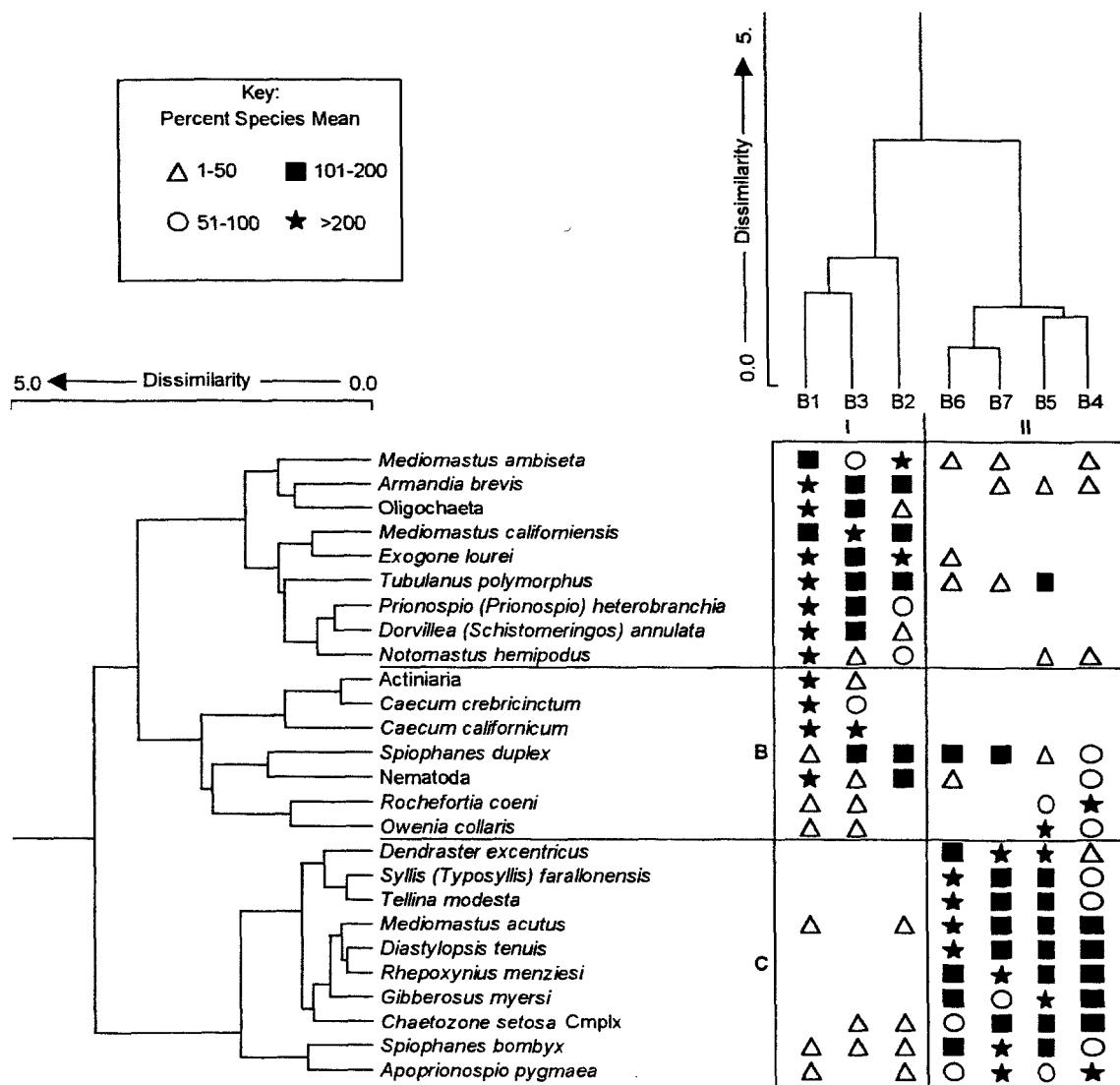


Figure 12. Two-way coincidence table resulting from normal (station) and inverse (species) classification dendograms for the 26 most abundant infaunal species. Haynes and AES Alamitos L.L.C. generating stations NPDES, 2001.

## Fish and Macroinvertebrates

### Video-cine Transects

Underwater video transects were conducted in both winter and summer of 2001 to evaluate the fish and motile macroinvertebrate populations in King Harbor. Data recorded for each transect are presented in Appendix H by station and replicate. A master list of species observed is presented in Appendix H-1. Tables and figures of parameters derived from these data are presented in the following text. Underwater visibility was approximately 10 m in both the winter and summer 2001 survey.

**Fish.** A total of 28 species and 5,631 individuals were observed during the surveys (Table 10). The nine species comprising more than 1% of the overall abundance together accounted for almost 97% of the total abundance, with the top two species comprising almost 71% of the total. The most abundant species was blacksmith (*Chromis punctipinnis*) which accounted for 48.4% of the total abundance, followed by sargo (*Anisotremus davidsonii*), accounting for 22.4% of the abundance. Señorita (*Oxyjulis californica*) accounted for 11.9% of the abundance, while salema (*Xenistius californiensis*) accounted for 4.9%. Rock wrasse (*Halichoeres semicinctus*) and jacksmelt (*Atherinopsis californiensis*) accounted for 2.3 and 2.0% of the abundance, respectively. Other species that contributed a large portion of the abundance included Pacific bonito (*Sarda chiliensis*) at 1.8%, pile perch (*Rhacochilus vacca*) at 1.6%, black perch (*Embiotoca jacksoni*) at 1.5%, and topsmelt (*Atherinops affinis*) at 0.8%. The remaining 18 species together accounted for slightly more than 3% of the total abundance.

**Table 10. Number, relative abundance, and rank of fish recorded along video-cine transects. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	Winter				Summer				Grand Total	Percent Comp.	Rank
	C1	C2	C3	Total	C1	C2	C3	Total			
blacksmith	1379	865	16	2260	101	300	63	464	2724	48.38	1
sargo	684	220	8	912	219	-	130	349	1261	22.39	2
senorita	178	289	4	471	80	40	77	197	668	11.86	3
salema	275	-	-	275	-	-	-	-	275	4.88	4
rock wrasse	124	1	-	125	4	-	1	5	130	2.31	5
jacksmelt	50	50	-	100	-	-	15	15	115	2.04	6
Pacific bonito	101	-	-	101	-	-	-	-	101	1.79	7
pile perch	1	26	-	27	35	9	16	60	87	1.55	8
black perch	3	4	8	15	33	-	34	67	82	1.46	9
topsmelt	-	-	-	-	-	45	-	45	45	0.80	10
kelp bass	8	-	7	15	5	-	8	13	28	0.50	11
white seaperch	1	1	1	3	-	-	21	21	24	0.43	12
garibaldi	14	-	2	16	5	-	-	5	21	0.37	13
barred sand bass	-	-	7	7	-	4	9	13	20	0.36	14
opaleye	8	-	-	8	8	-	-	8	16	0.28	15
halfmoon	-	-	-	-	1	7	-	8	8	0.14	16
orangethroat pikeblenny	-	-	-	-	5	2	-	7	7	0.12	17
spotted turbot	-	2	2	4	1	-	-	1	5	0.09	18
blackeye goby	-	-	1	1	-	-	2	2	3	0.05	19
Pacific angel shark	1	-	1	2	-	-	-	-	2	0.04	20
zebra perch	1	-	-	1	1	-	-	1	2	0.04	21
cabezon	-	1	-	1	-	-	-	-	1	0.02	22
California barracuda	-	-	1	1	-	-	-	-	1	0.02	23
California halibut	-	-	1	1	-	-	-	-	1	0.02	24
c-o turbot	-	-	1	1	-	-	-	-	1	0.02	25
olive rockfish	-	-	1	1	-	-	-	-	1	0.02	26
thornback	1	-	-	1	-	-	-	-	1	0.02	27
yellowtail	-	-	-	-	-	1	-	1	1	0.02	28
Number of individuals	2829	1459	61	4349	498	408	376	1282	5631		
Number of species	16	10	15	24	13	8	11	19	28		

Fish were approximately three times as abundant in winter than in summer and were orders of magnitude more abundant at each of the Units 7&8 discharge stations in winter, but were markedly similar at both the discharge and breakwater stations in summer (Table 10, Appendices H-2 and H-3). Station C1 is parallel to the Units 7 & 8 discharge conduit, Station C2 is perpendicular to the discharge conduit, and Station C3, the control station, is parallel to the breakwater. Abundance was greatest at Station C1 in winter and in summer. Abundance at the control station was six times more abundant in summer than in winter.

Species richness was not greatly different between the discharge and control station (which was intermediate to the two discharge stations). Lowest species richness was found at Station C2 in winter and in summer. When data from the two discharge stations were combined, slightly more species occurred at the discharge than at the control station (18 species at the discharge and 15 at the control station in winter; 16 species at the discharge and 11 species at the control station in summer). Two species, blacksmith and señorita were found at all stations in both winter and summer. Blacksmith, sargo, black perch, and white seaperch (*Phanerodon furcatus*) were recorded at all stations in winter, while three species, including blacksmith, señorita, and pile perch were recorded at both of the discharge stations and at the control station in summer. Nineteen species of fish were observed at Station C1, of which five, salema, Pacific bonito, opaleye (*Girella nigricans*), zebra perch (*Hermosilla azurea*), and thornback (*Platyrrhinoides triseriata*), were found there exclusively. Fifteen species were seen at Station C2, of which three, topsmelt, cabezon (*Scorpaenichthys marmoratus*), and yellowtail (*Seriola dorsalis*), were noted only at that station. Of the 18 species occurring at the control station (C3), five species, blackeye goby (*Coryphopterus nicholsi*), California barracuda (*Sphyraena argentea*), California halibut (*Paralichthys californicus*), C-O turbot (*Pleuronichthys coenosus*), and olive rockfish (*Sebastodes serranoides*) were exclusive there.

**Macroinvertebrates.** Overall, 129 individual motile macroinvertebrates, comprising nine species, were observed during the video survey (Table 11, Appendices H-2, H-3). The two most frequently observed species, accounting for almost 71% of the macroinvertebrates, were Kellet's whelk (*Kelletia kelletii*) accounting for 47% of the total and warty sea cucumber (*Parastichopus parvimensis*), accounting for 23% of all motile invertebrates. Wavy top turban snail (*Lithopoma undosa*) and California spiny lobster were also abundant, accounting for almost 18% and 4% of the abundance, respectively. The carnivorous tectibranch (*Navanax inermis*) was next most abundant, but was represented by only three individuals. Other species observed included Lewis' moon snail (*Euspira lewisi*), purple sea urchin (*Strongylocentrotus purpuratus*), California sea hare (*Aplysia californica*), and the two spot octopus (*Octopus bimaculatus*).

**Table 11. Number, relative abundance, and rank of macroinvertebrates recorded along video-cine transects. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	Winter				Summer				Grand Total	Percent Comp.	Rank
	C1	C2	C3	Total	C1	C2	C3	Total			
Kellet's whelk	24	10	5	39	12	7	3	22	61	47.29	1
warty sea cucumber	14	6	5	25	1	4	-	5	30	23.26	2
wavy top snail	17	6	-	23	-	-	-	-	23	17.83	3
California spiny lobster	-	-	-	-	-	-	5	5	5	3.88	5
navanax	-	2	-	2	-	-	1	1	3	2.33	6
Lewis's moon snail	1	2	-	3	-	-	-	-	3	2.33	7
purple sea urchin	-	-	2	2	-	-	-	-	2	1.55	8
California seahare	-	-	1	1	-	-	-	-	1	0.78	9
California two-spot octopus	-	-	-	-	-	1	-	1	1	0.78	11
Number of individuals	56	26	13	95	13	12	9	34	129		
Number of species	4	5	4	7	2	3	3	5	9		

Six invertebrate species were observed at the two discharge stations (four at Station C1 and six at Station C2); a very similar six species were noted during the same period at the control station (Table 11). Only Kellet's whelk, warty sea cucumber, and navanax were observed at both the discharge and control stations.

### Impingement

The results of heat treatment (HT) and normal operation (NO) fish impingement sampling at AES Redondo Beach L.L.C. generating station Units 5&6 and Units 7&8 for the sample year 2001 (1 October 2000 to 30 September 2001) are presented in their entirety in Appendix I. A master species list of species impinged during heat treatment and normal operations is presented in Appendix I-1. Derived tables and figures of fish and macroinvertebrate data are presented separately in the following text.

**Fish.** Fish were examined during 19 heat treatments and 22 normal operation surveys at Redondo Beach generating station.

**Species Composition.** The combined heat treatment and normal operation surveys at Units 5&6 and Units 7&8 yielded 57 species of fish, representing two classes and 27 families (Appendix I). Six families of cartilaginous (Elasmobranchiomorpha = Chondrichthyes), and 21 families of bony fish (Osteichthyes) were dominated by eight species of surfperch (Embiotocidae), seven species of croakers (Sciaenidae), and at least five species of rockfish (Scorpaenidae).

**Abundance.** Heat treatment and normal operation impingement catches at Units 5&6 and Units 7&8 combined yielded an estimated total of 9,256 individual fish (Table 12, Appendix I-2). Approximately 39% of the individuals were taken during the 19 heat treatments at the two intakes, whereas 61% were taken during normal operations. More than 99% were taken at Units 7&8.

**Table 12. Number of individuals of the 10 most abundant fish species impinged during heat treatment and normal operations. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	Units 5 & 6		Units 7 & 8		Overall	
	Total Abundance	Percent Total	Total Abundance	Percent Total	Total Abundance	Percent Total
queenfish	12	22.22	1723	18.72	1735	18.7
sargo	-	-	1058	11.50	1058	11.4
shiner perch	21	38.89	973	10.57	994	10.7
black perch	4	7.41	877	9.53	881	9.5
northern anchovy	2	3.70	837	9.10	839	9.1
California scorpionfish	-	-	529	5.75	529	5.7
giant kelpfish	4	7.41	513	5.57	517	5.6
jacksmelt	-	-	475	5.16	475	5.1
blacksmith	-	-	329	3.58	329	3.6
black croaker	-	-	202	2.20	202	2.2
<b>Survey Totals:</b>						
Number of individuals	54		9202		9256	
Number of species	11		56		57	

Eleven species comprised of 54 individuals were impinged at Units 5&6 during seven heat treatments and 337 days of flow (Table 12, Appendix I-3). No fish was taken during any of the eleven normal operation surveys. Average impingement was less than 0.16 fish per operational day at Units 5&6 in the 2001 survey year (Table 13).

Impingement data from Units 7&8 indicated that 9,202 individuals comprising 56 species were taken during 12 heat treatments and 352 days of flow (Table 12, Appendix I-5). Twenty-five

fish species were taken during 11 normal operation surveys for an estimated total of 5,610 fish impinged. Average impingement per operational day was about 26 fish. During the 12 heat treatment surveys, 3,592 individuals and 50 species were taken (Table 13).

**Table 13. Numbers of species, number of individuals, and biomass (kg) of fish impinged during heat treatments at Units 5&6 and 7&8. AES Redondo Beach L.L.C. generating station NPDES 2001.**

Date	Species	Number		Biomass
		Individuals	(kg)	
<b>Units 5 &amp; 6</b>				
30 Jan 01	1	1	0.29	
1 Mar 01	-	-	-	
1 Apr 01	-	-	-	
6 May 01	-	-	-	
24 Jun 01	2	5	0.22	
29 Jul 01*	9	44	18.19	
9 Sep 01	3	4	0.04	
<b>Units 7 &amp; 8</b>				
1 Oct 00	26	735	104.115	
5 Nov 00	19	301	24.225	
9 Jan 01	15	224	51.269	
27 Jan 01	24	215	51.001	
18 Feb 01	23	148	39.520	
25 Mar 01	27	450	156.632	
22 Apr 01	21	156	71.447	
22 May 01	17	240	81.805	
19 Jun 01	27	403	80.267	
17 Jul 01	13	124	41.800	
19 Aug 01	22	275	46.653	
23 Sep 01	20	321	58.086	
Overall	Total	51	3646	825.5483
	Mean	14.2	191.9	43.4

\* includes second cycle on 2 August 2001.

The ten most abundant species at Units 7&8 accounted for 82% of the impingement catch, with the remaining 46 species accounted for 22% of the abundance (Table 12, Appendix I-5). Queenfish was the most abundant species at Units 7&8, accounting for 18.8% of the abundance, sargo was second with 11.5%, shiner perch was third with 10.6%, black perch was fourth with 9.6%, and northern anchovy was fifth with 9.1% of the catch. The remaining five species of the ten most abundant accounted for 22% of the total abundance (Appendix I-5).

**Biomass.** Fish biomass totaled 1,736.2 kg for an average of slightly less than 5 kg per day during the 2001 survey year (Table 14, Appendix I-2). The ten species ranked highest in biomass were sargo, Pacific electric ray (*Torpedo californica*), black perch, horn shark (*Heterodontus francisci*), California scorpionfish, cabezon (*Scorpaenichthys marmoratus*), round stingray (*Urolophus halleri*), barred sand bass (*Paralabrax nebulifer*), barred surfperch (*Amphistichus argenteus*), and blacksmith; together these species weighed 1,495.1 kg, which accounted for 86.6% of the total biomass.

Total biomass impinged for the year at Units 5&6 was 18.7 kg, with a total of less than 0.05 kg per day of operations (Table 14, Appendix I-4). Barred sand bass accounted for 36.5% of the

The ten most abundant species at Redondo Beach generating station accounted for almost 81.9% of all the individuals taken at the Units 5&6 and Units 7&8 screenwells (Table 12). The most abundant species was queenfish (*Seriphis politus*) which accounted for 18.7% of the total. The second most abundant species was sargo (*Anisotremus davidsonii*), which accounted for 11.4% of the abundance. The remaining eight most dominant species, accounting for approximately 51.7% of the total abundance, were, in decreasing order of abundance, shiner perch (*Cymatogaster aggregata*), black perch (*Embiotoca jacksoni*), northern anchovy (*Engraulis mordax*), California scorpionfish (*Scorpaena guttata*), giant kelpfish (*Heterostichus rostratus*), jacksnelt (*Atherinopsis californiensis*), blacksmith (*Chromis punctipinnis*), and black croaker (*Cheilotrema saturnum*).

Only five of these most abundant species were taken at Units 5&6. Shiner perch, third most abundant overall with 10.8% of the abundance, was the most abundant species at Units 5&6, accounting for 38.9% of the 54 individuals taken. Queenfish was the second most abundant species with 22.2%, while the third most abundant species, walleye surfperch (*Hyperprosopon argenteum*), was 30<sup>th</sup> in overall abundance. One species, bat ray (*Myliobatis californica*), was taken uniquely at Units 5&6 (Appendix I-2).

biomass, while bat ray contributed 28.9%. The next three species were, in order of decreasing biomass, black perch, queenfish, and shiner perch, with 11.0%, 10.4%, and 7.2%, respectively (Appendix I-4).

**Table 14. The 10 fish species with the greatest biomass (kg) impinged during heat treatments and normal operations. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	Units 5 & 6		Units 7 & 8		Overall	
	Total Biomass	Percent Total	Total Biomass	Percent Total	Total Biomass	Percent Total
sargo	-	-	591.816	34.5	591.816	34.1
Pacific electric ray	-	-	251.932	14.7	251.932	14.5
black perch	2.068	11.0	157.202	9.2	159.270	9.2
horn shark	-	-	144.143	8.4	144.143	8.3
California scorpionfish	-	-	129.458	7.5	129.458	7.5
cabezon	-	-	59.568	3.5	59.568	3.4
round stingray	-	-	53.832	3.1	53.832	3.1
barred sand bass	6.840	36.5	36.477	2.1	43.317	2.5
barred surfperch	-	-	34.981	2.0	34.981	2.0
blacksmith	-	-	26.817	1.6	26.817	1.5
Survey Totals						
Biomass (kg)	18.728		1717.462		1736.190	

The Units 7&8 impingement biomass total was 1,717.5 kg, with an average of 4.8 kg per day (Table 14, Appendix I-5). The estimated biomass was almost evenly divided between normal operations (910.6 kg or 53%) and the 12 heat treatments (806.8 kg or 47%). Sargo dominated in terms of overall biomass, accounting for 34.7% of the catch (Appendix I-5). The next most dominant species in terms of biomass was Pacific electric ray, which contributed 14.8% of the biomass total. The next three species, black perch, horn shark, and California scorpionfish, together contributed 25.2% to the biomass. The remaining five species among the top ten, which individually contributed more than 1.5%, contributed an additional 12.4% of the biomass. They were cabezon, round stingray, barred sand bass, barred surfperch, and blacksmith. Together these 10 species accounted for 87.0% of the biomass. The remaining 13% (221.2 kg) of the biomass was distributed among 46 species.

**Size (Length).** Standard lengths (mm SL) for a maximum of 200 individuals per species were recorded during impingement surveys. These measurements were used to construct length-frequency histograms for selected species.

**Population Structure.** Three species were present in sufficient abundance to warrant construction of length-frequency histograms. The histograms reflect the structure of the population impinged by the generating station over time and do not necessarily reflect the structure of the population present offshore.

Examination of the population data for queenfish indicated a bimodal distribution, with a major peaks at 60 mm SL and a minor peak 150 mm SL (Figure 13). The population ranged from 30 to 190 mm SL, with most of the individuals between 50 and 70 mm SL.

The histogram for sargo indicated a broad size distribution with most individuals between 220 and 260 mm SL (Figure 14). The population ranged between the 70 to 340 mm size classes.

The population data for barred sand bass indicated a broad size distribution with peaks between 180 and 220 mm SL (Figure 15). The population ranged from 60 to 390 mm SL.

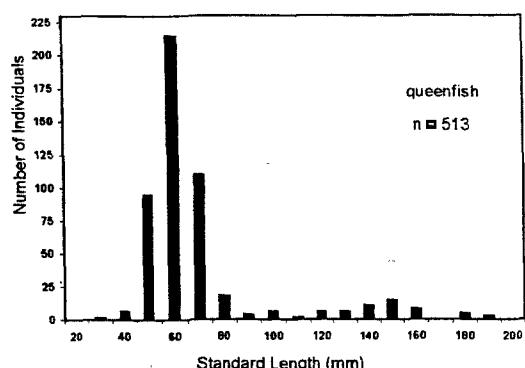


Figure 13. Length-frequency distribution of queenfish (*Seriphus politus*) taken during impingement surveys. AES Redondo Beach L.L.C. generating station NPDES, 2001.

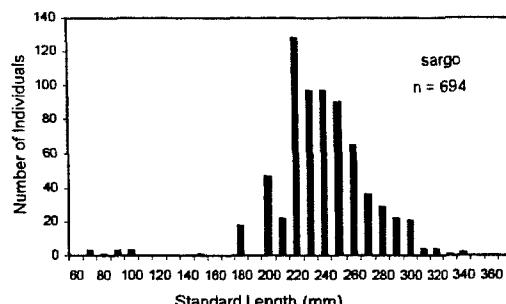


Figure 14. Length-frequency distribution of sargo (*Anisotremus davidsonii*) taken during impingement surveys. AES Redondo Beach L.L.C. generating station NPDES, 2001.

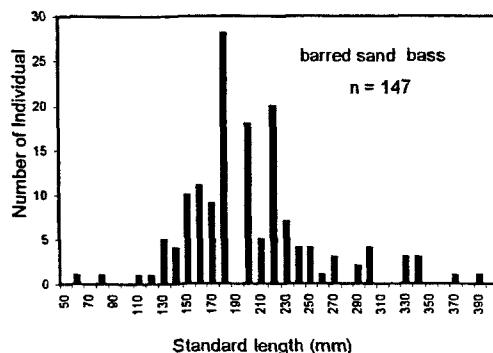


Figure 15. Length-frequency distribution of barred sand bass (*Paralabrax nebulifer*) taken during impingement surveys. AES Redondo Beach L.L.C. generating station NPDES, 2001.

**Diseases and Abnormalities.** Except for the following, no diseases or abnormalities were noted on any fish caught during the impingement surveys. One barred sand bass had a hook and line in its mouth during a heat treatment on 29 July 2001, and a parasitic fish louse, *Lironeca vulgaris*, was attached to a queenfish during a heat treatment on 5 November 2000.

**Macroinvertebrates.** In total, at least 29 macroinvertebrate species representing four phyla and 19 families (Appendix I-1), with an estimated total abundance of 3,722 individuals and an estimated total biomass of 1,383.2 kg, were impinged during the heat treatment and normal operation surveys at Units 5&6 and Units 7&8 (Table 15, Appendices I-12 to I-19). Arthropoda (all crustaceans) were represented by 10 species, mollusks by six species, echinoderms by at least four species, and cnidaria with two species.

The most abundant motile macroinvertebrate was California spiny lobster (*Panulirus interruptus*) with 68.6% of the abundance, and 76.4% of the biomass. California market squid (*Loligo opalescens*) was the second most abundant macroinvertebrate, with 6.7% of total abundance; it was third in biomass, with 4.9%. Third and fourth species in abundance were the lined shore crab (*Pachygrapsus crassipes*) and the sheep crab (*Loxorhynchus grandis*) with 4.0% and 3.6% of the abundance, and less than 1% and 7.6% of the biomass, respectively. Although California two-spot octopus (*Octopus bimaculoides*) was fourth in biomass (3.3%), it was eighth in abundance (2.4%). These five species contributed 85.8% of the abundance and 92.6% of the biomass. The remaining 24 species contributed slightly more than 14% of the abundance and less than 8% of the biomass (Table 15).

Differences in biomass and abundance catch data between Units 5&6 and Units 7&8 were substantial. There were no invertebrates taken during normal operation surveys at Units 5&6. Only 33 individuals with 8.6 kg in biomass were taken at Units 5&6, compared to an estimated 3,689

**Table 15. Number of individuals and biomass (kg) of the 10 most abundant macroinvertebrates impinged during heat treatment and normal operations. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	Units 5 & 6		Units 7 & 8		Station Total			
	Abund.	Biomass	Abund.	Biomass	Abund.	%	Biomass	%
California spiny lobster*	1	2.354	2552	1054.862	2553	68.59	1057.216	76.43
California market squid	-	-	249	68.257	249	6.69	68.257	4.93
striped shore crab	2	0.001	145	0.782	147	3.95	0.783	0.06
sheep crab	-	-	133	105.068	133	3.57	105.068	7.60
swimming crab	-	-	113	2.206	113	3.04	2.206	0.16
red rock shrimp	-	-	100	0.060	100	2.69	0.060	0.00
Pacific rock crab	5	0.024	88	0.114	93	2.50	0.138	0.01
California two-spot octopus	2	1.600	87	44.371	89	2.39	45.971	3.32
pencillate jellyfish	-	-	57	40.803	57	1.53	40.803	2.95
red octopus	-	-	42	4.184	42	1.13	4.184	0.30
Survey Totals	33	8.641	3689	1374.592	3722		1383.233	
Total Species	14		23		29			

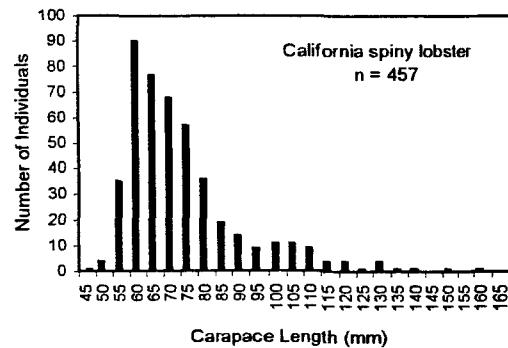
Note: 0.00 = <0.005

\**Panulirus interruptus* extrapolation was adjusted due to high abundance and biomass on a single sampling date.

The average of all sampling dates was used to calculate the extrapolation

individuals with 1,374.6 kg of biomass at Units 7&8. Six species were unique to Units 5&6 impingement, while 15 species were unique to Units 7&8.

Because of the sport and commercial importance of California spiny lobster, carapace lengths (mm CL) were recorded to determine the size frequency of entrained individuals. This species was sufficiently abundant overall to allow construction of a length-frequency histogram of the catch. The screenwells are inspected daily, and live California spiny lobsters are recovered and returned to the ocean. The return rate is greater than 90%. In 2001, size distribution of California spiny lobster peaked at 60 mm CL, though a wide range of size classes was impinged (Figure 16). Overall, carapace lengths ranged from 45 to 160 mm CL, but the bulk of the population was between 60 and 80 mm CL, just below the legal take size at 83 mm CL.



**Figure 16. Length-frequency distribution of California spiny lobster (*Panulirus interruptus*) taken during impingement surveys. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

## DISCUSSION

### WATER COLUMN MONITORING

#### Temperature

Past NPDES surveys have demonstrated that water temperatures in King Harbor are usually warmer than those just outside the harbor in nearshore Santa Monica Bay (EQA/MBC 1973, MBC 1979, 1981, 1986, 1988, 1990-1994a, 1995-1999a, 2000). King Harbor is a man-made, semi-enclosed basin where exchange of water with the open ocean is limited. Factors such as nearshore

currents and wave- and surf-induced turbulence do not have any significant effect on thermal dispersion within the harbor (EQA/MBC 1973). Volume and temperature of cooling water discharged from Units 7&8 can have a strong influence on water temperature in the harbor. In winter 1999 and winter 2000 Units 7&8 were not operating and average surface and bottom temperatures in King Harbor were similar to or less than average temperatures at the offshore stations (MBC 1999a, 2000). In winter 1997, however, Units 7&8 were operating (two circulator pumps discharging water approximately 7°C above ambient), and average surface temperatures in the harbor were 1 to 2°C warmer than offshore (MBC 1997).

During the winter 2001 survey, average surface temperatures in the harbor were 1 to 2°C warmer than offshore, and average bottom temperatures in the harbor were 0.6 to 0.8°C warmer than offshore. On the day of sampling, the cooling water discharged from Units 7&8 was 5°C warmer than ambient, while that from Units 5&6 was more than 15°C above ambient (Gusters 2002, pers. comm.). Slightly warmer temperatures in the upper one-half of the water column recorded at almost all stations during afternoon flood tide sampling likely resulted from solar insolation. Thermoclines were recorded at most harbor stations, but were only present offshore at Station RW9 (at the harbor entrance) and at Station RW10 (at the Units 5&6 discharge). Average King Harbor temperatures in winter 2001 were 3 to 5°C warmer than in winter 2000, and Santa Monica Bay temperatures were similar to or lower than temperatures recorded last winter (MBC 2000). However, all temperatures were within ranges previously reported in the study area (EQA/MBC 1973, MBC 1979, 1981, 1986, 1988, 1990-1994a, 1995-1999a, 2000).

In summer 2001, average surface temperatures in the study area were 2 to 5°C warmer than in winter. Average surface temperatures in King Harbor were 2 to 3°C warmer than offshore, though average bottom temperatures were similar between the two areas. Slightly warmer temperatures in the upper one-half of the water column recorded at all stations during afternoon ebb tide sampling likely resulted from solar insolation. During summer sampling, the generating station was discharging water 11°C warmer than ambient in King Harbor (Units 7&8), while water discharged from Units 5&6 was slightly cooler than ambient (Gusters 2002, pers. comm.). Thermoclines were recorded at all harbor stations, and were present at several offshore stations. At the offshore stations, most thermoclines were mid-depth or deeper, though at Stations RW10 (at the Units 5&6 discharge) and RW12 (downcoast and offshore of the Units 5&6 discharge) the thermoclines were recorded in the upper three meters of the water column. Average temperatures in King Harbor and Santa Monica Bay in summer 2001 were similar to or lower than temperatures in summer 2000. All temperatures were within ranges previously reported in the study area (EQA/MBC 1973, MBC 1979, 1981, 1986, 1988, 1990-1994a, 1995-1999a, 2000).

### Dissolved Oxygen

The concentration of dissolved oxygen (DO) in nearshore waters is affected by physical, chemical, and biological variables including biological activity, temperature, winds, and currents caused by tides and wave action. High DO concentrations may be the result of cool water temperatures (solubility of oxygen in water increases as temperature decreases), active photosynthesis, and/or mixing at the air-water interface (Sverdrup et al. 1942). Conversely, low concentrations may result from high water temperatures, high rates of organic decomposition, and/or extensive mixing of surface waters with oxygen-poor subsurface waters.

During winter, DO concentrations in King Harbor and in Santa Monica Bay were fairly uniform from surface to bottom and between tides. Values generally increased slightly from the surface to a mid-depth maximum, then decreased to the bottom, or simply increased slightly from surface to bottom. Dissolved oxygen concentrations were generally lower in the harbor than concentrations measured in Santa Monica Bay, corresponding to higher temperatures in King Harbor. During the afternoon flood tide, slightly higher DO concentrations at all stations in King

Harbor and Santa Monica Bay likely resulted from increased primary production. Dissolved oxygen concentrations in the upper one-half of the water column at several stations near the Units 5&6 discharge were slightly higher than those elsewhere. This was likely the results of a plankton bloom (red tide), which was noted at several stations in the vicinity of the Units 5&6 discharge (and extending up to the Hermosa Beach Pier). As phytoplankton thrive, they produce more oxygen than they consume. Dissolved oxygen values recorded in winter 2001 were similar to those recorded in winter 2000, as well as those reported in other previous surveys in the study area (EQA/MBC 1973, MBC 1979, 1981, 1986, 1988, 1990-1994a, 1995-1999a, 2000).

In summer, offshore and harbor DO concentrations were slightly lower than those recorded in winter. As in winter, DO concentrations in the harbor were slightly lower than those measured in Santa Monica Bay, corresponding to higher temperatures in King Harbor. Dissolved oxygen varied little throughout the water column, especially at offshore stations. Surface concentrations were slightly higher during the afternoon ebb tide, likely resulting from increased primary production. Dissolved oxygen concentrations recorded in summer 2001 were slightly lower than those recorded in summer 2000, but similar to those recorded in 1999 (MBC 1999a, 2000). All DO concentrations were within the range of those previously reported in the study area (EQA/MBC 1973, MBC 1979, 1981, 1986, 1988, 1990-1994a, 1995-1999a, 2000).

#### Hydrogen Ion Concentration

In the open ocean, the hydrogen ion concentration (pH) remains fairly constant due to the buffering capacity of sea water (Sverdrup et al. 1942). However, in nearshore areas, pH may be more variable due to physical, chemical, and biological influences. For instance, in areas with a large organic influx, such as bays, estuaries and river mouths, microbial decomposition increases. Along with a reduction in dissolved oxygen, decomposition also results in the production of humic acids, which decrease pH (Duxbury and Duxbury 1984). Reduced pH values may also occur in areas of fresh water influx, since fresh water has a lower pH than salt water. In contrast, phytoplankton blooms, which are often associated with nearshore upwelling, may cause pH to increase. High photosynthetic rates increase the removal of carbon dioxide(in the form of carbonate ions) from water, thus reducing the carbonic acid concentration and raising pH.

During the winter survey, pH values throughout the water column were fairly similar among stations and between tides. Higher pH values were recorded at several of the Santa Monica Bay stations just below the surface, likely resulting from increased primary production at those stations. During the summer survey, pH was less variable than in winter, with all recorded values in the study area between 7.86 and 8.03. Winter 2001 pH values were slightly higher than those in winter 2000, while values recorded in summer 2001 were slightly lower than those recorded in summer 2001 (MBC 2000). However, all pH values were within the range of those previously reported in the study area (EQA/MBC 1973, MBC 1979, 1981, 1986, 1988, 1990-1994a, 1995-1999a, 2000).

#### Salinity

Salinity in the open ocean is generally 35 parts per thousand (ppt); that is, a 1,000-g sample of ocean water contains 35 g of dissolved compounds, collectively referred to as salts (Sverdrup et al. 1942). In nearshore areas subjected to freshwater influx, however, salinity is usually slightly lower. In southern California, salinity of nearshore waters is generally between 33 and 34 ppt (Dailey et al. 1993). Reductions in nearshore salinity usually result from freshwater input, while slight increases are often associated with upwelling of colder, more saline bottom waters.

Salinity profiles from the winter and summer surveys were near vertical, with some mid-water and near-bottom fluctuations at some stations in King Harbor. In winter and summer 2001, salinity at the surface at Station RW6, a relatively shallow station located between the Units 7&8

discharge and Basin 3, was about 0.5 ppt lower than at the other King Harbor stations. In both winter and summer, near-surface salinity at Station RW6 was lower during flood tide than during ebb tide. In winter at Station RW8, salinity increased greatly near the bottom, whereas near-bottom salinity increased only slightly at the other harbor stations. A similar pattern was noted at Station RW5 in summer during flood tide. Reasons for the differences in salinity at these harbor stations are unknown. The occurrence of these anomalies at stations distant from the Units 7&8 discharge suggest the generating station is not influencing salinity in the harbor. All salinity values at the offshore stations in 2001 were within the range of values considered normal for nearshore areas of the Southern California Bight.

## SEDIMENT MONITORING

### Sediment Grain Size

Sediments in the study area in 2001 were composed primarily of sand (52% to 97%), with an average mean grain size of 2.55 phi (in the fine sand category). Percentage of sand was more variable among the three King Harbor stations (B1 through B3) than among the four offshore stations (B4 through B7). Among King Harbor stations, sediments at Station B3, located at the entrance to King Harbor, contained the highest percentage of sand, due to the station's proximity to the entrance where constant water movement prohibits finer materials from settling. All stations in King Harbor are situated relatively close to the Units 7&8 discharge, and potential turbulence caused by the discharge does not appear to have had a great effect on sediment composition. Poor sediment sorting found at harbor stations was probably primarily due to swells reflecting and refracting inside the mouth of the harbor. Strong water movement suspends and carries away fine particles, leaving the coarser particles behind. Historically, sediments at Station B2 have had the highest proportion of silt of all the harbor stations due to their location being slightly further away from the Units 7&8 discharge. However, when compared to past surveys, sediments at Station B2 in the 2001 survey contained the second lowest proportion of sand and the highest proportion of silt/clay ever recorded (Appendix D). Given the distance of Station B2 to the Units 7&8 discharge, and that Redondo Beach generating station did not experience any appreciable reduction in flow in 2001, it is unlikely that the higher proportion of silt at Station B2 was influenced by the discharge.

In summer surveys since 1978, sediments have been very similar among the Santa Monica Bay stations (MBC 1979, 1981, 1986, 1990-2000 and Appendix D). Sediments tend to be well sorted with a mean grain size in the fine to very fine sand category. A continuing trend, with the exception of Station B7 in 1999, suggests the Units 5&6 discharge is not affecting offshore sediments. In 1999, at Station B7, sediments were characterized by a mean grain size of 0.30 phi, nearly four times coarser than sediments from Station B4, nearest the discharge point. Mean grain size at Station B7 in the 2001 survey was 3.14 phi, similar to most values recorded since 1978 for Station B7.

Sediments at all stations in 2001 were finer than average (taken as an average over all years sampled since 1978), following two years when they were coarser than average, including 1999, which were the coarsest sediment samples on record (Figure 17). Sediments at the Units 7&8 discharge have varied among years. Mean grain size has been in the fine sand category in eight of fifteen surveys and in the medium sand category in the remaining seven surveys (MBC 1979, 1981, 1986, 1990-2000). The discharge flow appears to influence the sediments only in the immediate vicinity. In addition to being coarse and moderately poorly sorted, sediments around the discharge contain large amounts of broken shell and other small debris ejected following heat treatments at the generating station. Therefore, sediments at the discharge are distinctively different from those elsewhere. There has been great variability in mean grain size in the study. At Station B4, nearest the Units 5&6 discharge structure, 2000 and 1999 values were the coarsest values since 1978. Reasons for the coarser sediments offshore are unknown. However, sediments at Station B7 (4,400 ft upcoast of the Units 5&6 discharge) have been known to contain a high proportion of coarse

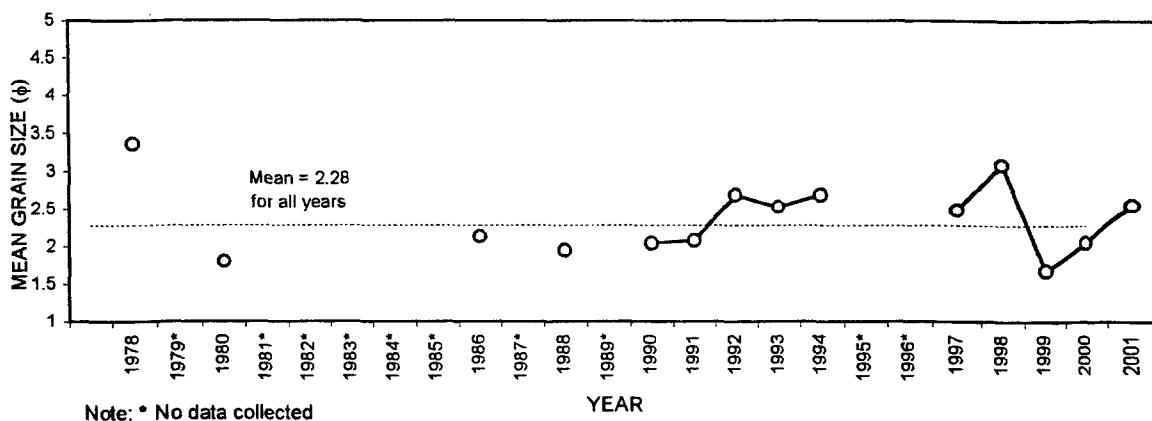


Figure 17. Comparison of sediment mean grain size, 1978 - 2001. AES Redondo Beach L.L.C. generating station NPDES, 2001.

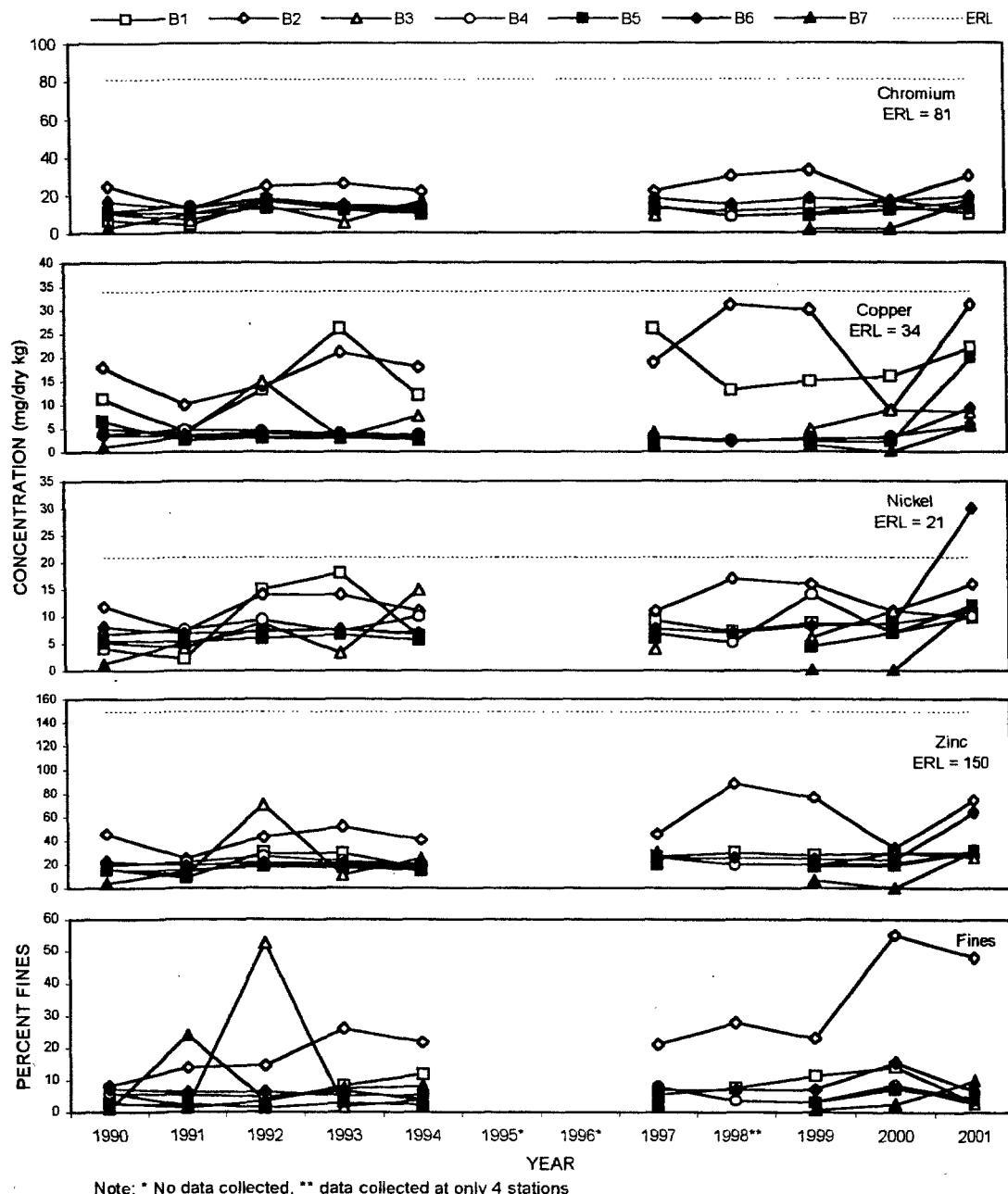
materials in past surveys, notably in 1999. This suggests that natural macro- and micro-scale processes may have more influence on sediment grain size composition than the generating station discharge. Moreover, any effect of the discharge on grain size is probably only a localized phenomenon that is unlikely to influence sediment characteristics at any appreciable distance away.

### Sediment Chemistry

In 2001, among offshore stations, highest sediment metal concentrations were detected at Stations B6 and B5 (Figure 18). Past surveys suggested a spatial pattern of decreasing metal concentrations with distance from Station B4, near the Units 5&6 discharge (MBC 1990-1994a). However, in 1997 this pattern was no longer apparent, and in 1998 concentrations of chromium, nickel, and zinc were lower at Station B4 than at Station B6, and levels of copper at the two stations were nearly identical (MBC 1997, 1998). A similar pattern was seen in 1999, where concentrations of chromium, copper, and zinc were higher at Station B6 than at Station B4 (MBC 1999). This recent trend continued in 2001, when chromium, nickel, and zinc concentrations were highest at Station B6. Mean sediment metal concentrations in 2001 were generally higher (except nickel) in King Harbor than in Santa Monica Bay.

Despite the shift in spatial patterns of metal concentrations in recent years, the metal levels at the offshore stations had remained consistent since 1990; however, in 2001 levels at offshore stations were all above the mean and were some of the highest levels recorded (Figure 18). The levels inside of the harbor have been much more variable. For example, in 1994, elevated levels of chromium and nickel were found at Station B3, near the harbor entrance, while in 1997, the levels for chromium and nickel at Station B3 were the lowest of the survey (MBC 1994a, 1997). Copper levels have been particularly variable, and since 1992 have been highest at Stations B1 and B2. Potential sources of these metals are the use and maintenance of boats, anti-fouling boat paints, protective metal plating, and metal alloys used in the structures of boats, piers, and docks. An assessment of metal levels throughout King Harbor found levels of metal contaminants to be 4 to 20 times higher in the inner harbor than in the outer harbor area, indicating that the metals in the harbor sediments are from a source other than the generating station discharge (MBC 1991).

In 2001, the historic spatial pattern in the distribution of metal concentrations in the harbor was noted (Figure 18). Station B2 has historically had the highest metal concentration values. In 1998, metal concentrations at Station B2 neared or exceeded the highest metal values detected since 1990. In 2000, peak concentrations dropped from 1999 levels by about 50% for all metals



**Figure 18. Comparison of sediment metal concentrations and percent fines by station, 1990 - 2001.**  
AES Redondo Beach L.L.C. generating station NPDES, 2001.

except nickel which dropped by 30%. The return to more normal values in the 2001 survey indicates that metal concentrations would correlate with increased distance from the discharge. Stochastic sampling effects have far greater influence on results when metal levels are low, and when values between stations are similar, as was the case in the 2000 survey. In 2001, elevated metal concentrations at Station B2 were probably due to the high percentage of fine material in the sediments; sediments at that station had almost 15 times the amount of silt and clay than sediments

at Station B1. However, in the previous year 2000, percent fines at Station B2 were more than twice that of 1999 values, yet metal concentrations at that station in 2000 were half that of 1999 results. Differences in metal concentrations among sites are often directly related to the sediment composition: fine-grained sediments may contain higher amounts of metals due to the greater available surface area (Ackermann 1980, de Groot et al. 1982). Comparisons, therefore, should take into account the relative amounts of fine and coarse sediment. The apparent change in sediment metal concentrations within the harbor with time may be attributed to the distribution of fines within the harbor, which has been quite variable over time.

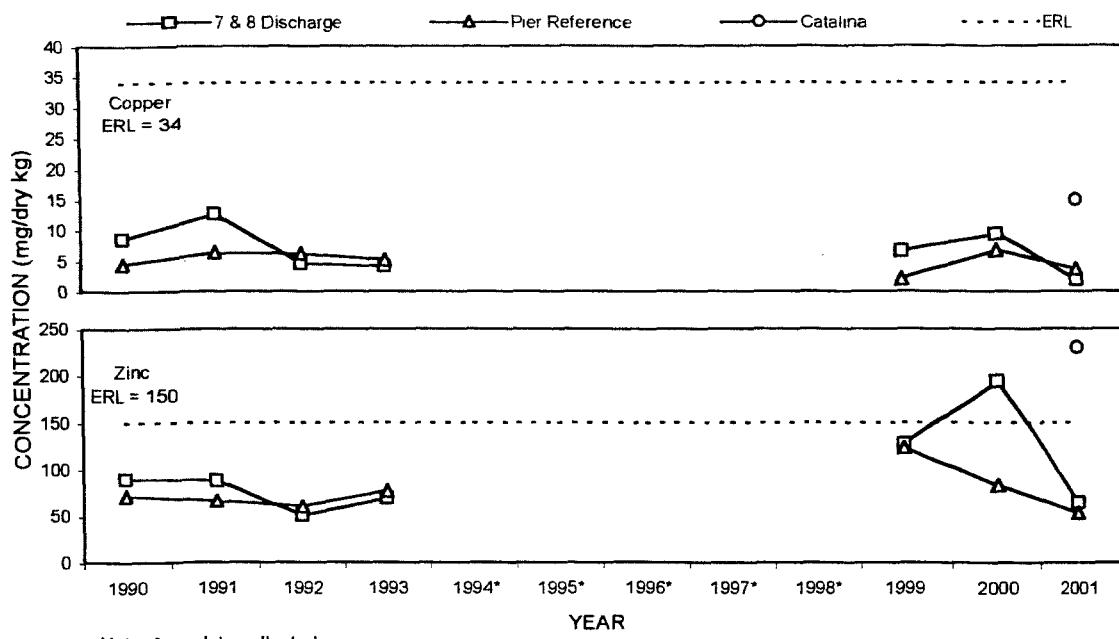
Elevated sediment metal levels may be toxic to some organisms. Ranges of toxicity have been developed by the National Oceanic and Atmospheric Administration (NOAA) (1991) and later updated (Long et al. 1995) using data from spiked sediment bioassays, sediment-water equilibrium partitioning, and the co-occurrence of adversely affected fauna and contaminant levels in the field. Chemical concentrations believed to be associated with adverse biological effects from the various independent studies were compared for each parameter and the lower 10 percentile was designated as the "Effects Range-Low" (ERL). The median of concentration levels was designated the "Effects Range-Median" (ERM). The ERL values are 81 mg/kg for chromium, 34 mg/kg for copper, 20.9 mg/kg for nickel, and 150 mg/kg for zinc. Historically metal concentrations have remained well below ERL levels, although values for copper and nickel at Station B2 approached the ERL levels in 1998 and 1999. In 2001, mean metal levels approached the ERL value for copper at Station B2 and was over the ERL value for nickel at Station B6, but well below the ERM level of 51.6 mg/kg for nickel. Other values were all considerably lower than their respective ERL values.

Metal levels have remained relatively constant since 1990, with more variability found among the harbor stations. In 2001, levels were generally higher than in past surveys, probably as a result of the high percentage of fines noted at Station B2. Distribution of metals in the study area appears to be historically linked to localized sediment grain size, unrelated to the generating station discharges. There was no indication that operation of the generating station had an appreciable effect on sediment metal levels.

#### MUSSEL BIOACCUMULATION

In 2001, copper and zinc were detected in mussels from the Units 7&8 discharge in King Harbor, and in samples collected outside the harbor at an upcoast pier reference site and at Santa Catalina Island. Levels of copper in mussels from the Units 7&8 discharge were similar to the maximum levels detected in mussel tissue from the pier reference site. Copper values at the discharge, where found, were intermediate in values noted at the pier reference site although the mean for all stations would suggest that levels were lower at the discharge. All analyzed metal concentrations in mussel tissue in 2001 were the lowest or almost the lowest in the long-term record. Chromium and nickel were greatest at the discharge in 1990, copper at the discharge in 1991, and zinc at the discharge in 2000 (Figure 19 and Appendix F). Concurrently, concentrations of all metals at the pier reference station in 2001 were the lowest or almost the lowest of surveys since 1991.

In 1988, California State Mussel Watch (CSMW) found levels of copper between 16 and 23 mg/dry kg in resident California mussels (*Mytilus californianus*) collected in Santa Monica Bay (SWRCB 1990). An overview of copper concentrations in whole *M. edulis* found by CSMW and NOAA in the Southern California Bight from 1980 to 1986 found copper tissue levels ranging from 4 to 120 mg/dry kg (NOAA 1991). One conclusion was that copper is a contaminant in mussels principally near major recreational and industrial harbors, and secondarily near other harbors. Copper level in mussels collected at the Units 7&8 discharge since 1990 have contained copper at concentrations of 4 to 21 mg/dry kg. These results suggest the operation of the generating station is not elevating copper above normal levels.



Note: \* no data collected

**Figure 19. Comparison of copper and zinc concentrations in bay mussel tissue at Units 7&8 discharge and at reference sites. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

In the same CSMW and NOAA studies, zinc concentrations ranged from 80 to 560 mg/dry kg (NOAA 1991), while in the 2001 survey, zinc concentrations in King Harbor mussels averaged 64 mg/dry kg. These values are the lowest recorded values since mussel tissue monitoring was initiated in 1990, and were below the range seen in the CSMW and NOAA studies. The pier reference site zinc concentrations averaged 54 mg/dry kg, also below the lowest values recorded in the CSMW and NOAA studies. Since all recorded concentrations at the discharges and at the pier reference site fell within the lower one third of the CSMW and NOAA range, it is unlikely that the operation of the Redondo Beach generating station has enhanced metal concentrations in the study area.

## BIOLOGICAL MONITORING

### Benthic Infauna

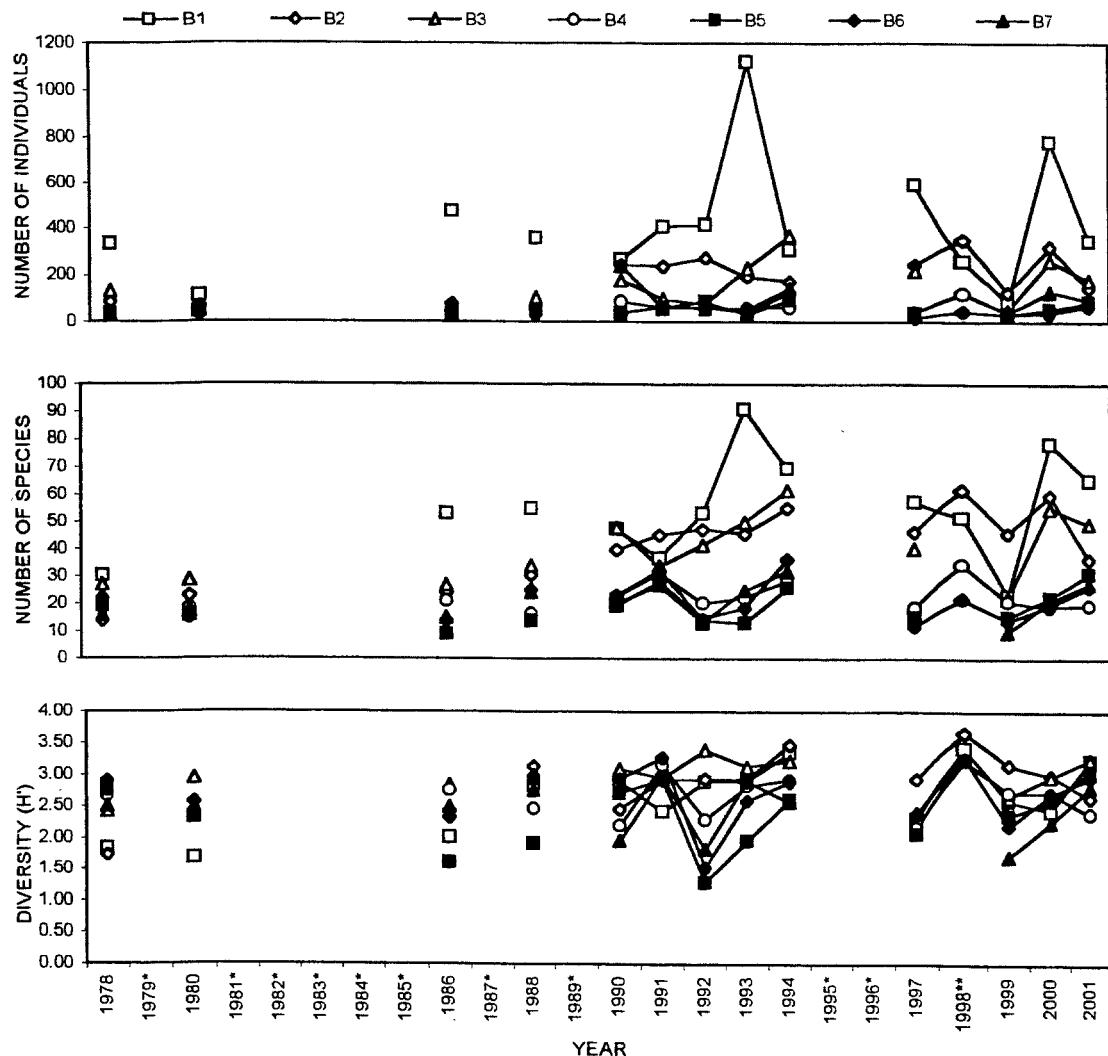
In 2001, the infaunal communities at the stations in King Harbor were almost three times as abundant (average density of 22,490 individuals/m<sup>2</sup>) and more than twice as speciose on average as those in Santa Monica Bay (average density of 7,900 individuals/m<sup>2</sup>). Community composition also differed between the harbor and offshore. Within the harbor, abundance, species richness, and biomass were greatest at Station B1, at the Units 7&8 discharge; species diversity was highest at Station B3, nearest the harbor entrance. Composition of the infaunal community was similar among the three stations, with *Mediomastus ambiseta* (in previous surveys, combined with *M. californiensis* as *Mediomastus* spp.) and other polychaete worms, oligochaete worms, sea anemones, and tube snails dominating the communities. The primary difference between stations was the high abundance of oligochaetes, anemones, and tubesnails at Station B1, and the absence or low abundance of these species at Station B2. Among the four stations outside the harbor, the infauna communities were similar in abundance and composition. Dominants at those communities were *Apopionospio pygmaea* and other polychaete worms, small amphipod and cumacean arthropods, and Pacific sand dollars.

Composition of the infauna community reflects the sediments in which it lives. Sediment grain size and particle sorting are particularly important. Sediments at all of the harbor stations were poorly sorted, but those at Stations B1 and B3 were much coarser, with large amounts of shell fragments and small pebbles. Poorly sorted sediments provide a greater variety of available niches, from sand and shell fragments large enough for attached organisms to fine silt and clay that contain considerable organic material. The sediments at Stations B1 and B3 supported several suites of species, from hard-substrate residents (anemones, the half-slippersnail *Crepidatella dorsata*, calcareous tube-building spirorbid worms, and barnacles) living on mollusk and barnacle shell fragments and pebbles, to surface detritus and deposit feeders (the annelids *Mediomastus ambiseta*, *M. californiensis*, *Notomastus hemipodus*, *Prionospio heterobranchia*, and the amphipods *Photis brevipes* and *Aoroides exilis*), to subsurface deposit feeders (oligochaetes, the polychaetes *Armandia brevis* and *Dorvillea annulata*, and nematodes), to grain lickers (the tubesnails *Caecum californicum* and *C. crebricinctum*), to predators (the nemerteans *Tubulanus polymorphus* and *Paranemertes californica*), resulting in greater species richness and diversity (Fauchald and Jumars 1979). Populations of very small organisms, such as *Mediomastus*, oligochaetes and nematodes, may be very large, resulting in high total abundance. The infauna community at Station B2 was somewhat similar to the communities at Stations B1 and B3, but because the sediments were finer, the hard-substrate and coarse-grain species were absent. The dominant species found in King Harbor were typical for communities from similar sediment types in southern California harbors (MBC 1994b, 1999b).

Sediments in Santa Monica Bay were better sorted than those in King Harbor, and this difference was reflected in the infauna communities. Communities dominants were similar among the four stations and included surface deposit feeders (the polychaete annelids *Apopriionospio pygmaea*, *Spiophanes bombyx*, and *Mediomastus acutus*, the amphipods *Rhepoxynius menziesi* and *Gibberosus myersi*, the cumacean *Diastylopsis tenuis*, and Pacific sand dollar, which is also a suspension feeder), filter feeders (such as the clam *Tellina modesta*), and predators (the polychate *Syllis farallonensis*) (Timko 1976, Fauchald and Jumars 1979, Word 1980). All of the sand dollars were very small; the largest animal taken in the survey was a medium-sized spiny sand star (*Astropecten armatus*) from Station B4. The infaunal communities found at the four offshore stations are typical of the shallow nearshore fine-sand habitats in the Southern California Bight (Barnard et al. 1959; Barnard 1960, 1963; MBC 1994a, 1999a). Abundance, species richness and diversity were slightly lower at Station B4, at the Units 5&6 discharge, than at the two adjacent stations, but the community composition was essentially equivalent, suggesting that the discharge had little influence on the infauna.

Abundance and species richness have historically been higher and more variable at stations in King Harbor than at the offshore stations (Figure 20). Sediment characteristics have also been more variable in the harbor, although sediments have consistently been poorly sorted (Appendix D-2). Infaunal abundance throughout the study area in 2001 was 61% of the abundance in 2000 and was very similar to the average abundance for the previous 13 summer surveys (average density of 14,400 individuals/m<sup>2</sup>) (MBC 1979, 1981, 1986, 1988, 1990-1994a, 1997-1999a, 2000). Average species richness (37 species) was greater than the long-term average (31 species). However, abundance and species richness have not varied in the same way at each of the stations. For example, at the three harbor stations abundance and richness were lower in 2001 than in 2000, but at the four offshore stations they were higher than in 2000, with the exception of lower abundance at Station B7. Average species diversity in 2001 was the same as in 2000 and was similar to the long-term average. Values at five of the stations were greater than in 2000 and those at two stations (Stations B2 and B4) were below the values for the previous year.

In 2001, the infauna community was most abundant at Station B1, at the Units 7&8 discharge, as it has been in all previous surveys except in 1994, 1998, and 1999, when it was most abundant at either Station B2 or B3 (Figure 20) (MBC 1979, 1981, 1986, 1988, 1990-1994a, 1997-



Note: \* no data collected, \*\* data collected at only 4 stations

**Figure 20. Comparison of infaunal community parameters (replicate means), 1978 - 2001. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

1999a, 2000). Species richness was also greatest at Station B1 in 2001, as in eight of the 13 previous surveys, with highest richness at either Station B2 or B3 in the other five years. However, among the three harbor stations, species diversity values have been highest at either Station B2 or B3, never at Station B1, because that community has typically been dominated by a few extremely abundant species. Among the offshore stations, abundance was greatest at Station B7 and species richness and diversity were greatest at Station B5 in 2001. No clear long-term trend is apparent among the offshore stations, although the three infaunal community parameters have more frequently been greatest at Station B4, at the Units 5&6 discharge.

Infaunal composition has varied since monitoring began in 1978, with the most notable changes occurring between the 1980 and 1986 surveys (MBC 1981, 1986). The community at Station B1, at the Units 7&8 discharge, has been particularly variable, due to fluctuations in sediment characteristics. In 1978 and 1980, the community at Station B1 was dominated by

*Armandia brevis*, *Capitella capitata*, and oligochaetes. This group, along with smaller numbers of other species, such as *Ophryotrocha puerilis*, has been associated with habitats with high amounts of organic material, such as areas near domestic and industrial sewage outfalls (Reish 1955, Word et al. 1977, SCCWRP 1990). *Capitella capitata* in particular is a cosmopolitan indicator of contamination and/or disturbance. It has been found only in very low abundance since 1990. Beginning in 1986, the dominant species at Station B1 were oligochaetes, *Dorvillea annulata*, *Caecum crebricinctum* and *C. californicum*, *Protodorvillea gracilis*, and *Saccocirrus* sp., the last two of which were present but not abundant in 2001 (MBC 1986, 1988, 1990-1993, 1997, 1999, 2000). This species group, referred to as interstitial, is associated with coarse sediments (Swedmark 1964). Oligochaetes, which are common in bays and harbors of southern California, were abundant in both groups (MBC 1981). The high abundance typically found at Station B1 has resulted from the presence of this unique community whose constituents occur in high numbers, recruiting and reproducing rapidly, and from the variety of niches available due to poorly sorted sediments containing large particles such as shell fragments. Changes in community composition, particularly between 1980 and 1986, have probably been due to the decrease in both discharge volume and number of heat treatments performed at the generating station. Material ejected from the discharge terminus during heat treatments is composed of shell fragments and dead and moribund animals that accumulate rapidly. The organic material is utilized by filter feeders and deposit feeders which can tolerate the sulfides that develop and, thereby, maintain community productivity (Knox 1977). With less shell and organic material being deposited, the interstitial community species predominated, although the community may shift back and forth between the two types, or be a combination of the two, depending on the organic load contributed by the discharge. When the lack of turbulence allows finer sediments to settle near the discharge terminus, the community at Station B1, dominated by nematodes and *Mediomastus* spp., more closely resembles those at the other two harbor stations, as it did in 1999 and 2000. The community at Station B3 results from its position near the entrance to the harbor, where it is subjected to varying degrees of water movement, depending on tides and weather. When the water is turbulent, sediments and the resulting community resemble those at the Units 7&8 discharge, and when conditions are calm, they are more similar to those at Station B2, further inside the harbor.

The infaunal communities offshore in Santa Monica Bay have been more similar among stations and surveys than those in King Harbor (MBC 1979, 1981, 1986, 1988, 1990-1994a, 1997-1999a, 2000). They have also differed considerably from those in the harbor, in abundance, species richness and species composition. Generally, the offshore communities have been dominated by the annelids *Apopriionospio pygmaea*, *Spiophanes bombyx*, *Owenia collaris*, *Chaetozone setosa*, and *Pectinaria californiensis*, the cumacean *Diastylopsis tenuis*, the amphipods *Rhepoxygnus menziesi* and *Gibberosus myersi*, and the clam *Tellina modesta*, species that are typical of the nearshore sand habitat (Barnard et al. 1959). Pacific sand dollars have frequently been abundant, and when the individuals were large, dominated the structure of the infauna community. The communities at Station B4, at the Units 5&6 discharge, have not differed from those at the other offshore stations.

## Fish and Macroinvertebrates

### Video-cine Transects

In 2001, more than 5,600 individuals representing 28 fish species were observed during the video-cine surveys. Most of the individuals in 2001 (92%) were observed near the discharge, at Stations C1 and C2. Species richness at the control station, Station C3, was intermediate between that of the two discharge stations. Species richness in 2001 was higher than in 2000 (25 species), was higher than the long-term mean of 21 species, and was the highest species total in the 12 years that surveys have been conducted since 1986 (Table 16, MBC 1986, 1988, 1990-1994a, 1997-1999a, 2000). Overall, mean fish species richness for winter was 16 species; the 24 species noted in 2001 was the highest observed. Species richness during summer was intermediate but still

exceeded the long-term mean of 18 species. Summer surveys from 1986 to 1993 typically found 15 to 17 species, but richness was considerably higher in 1994 (24 species) and relatively high in 2000, at 22 species (Table 16).

**Table 16. Total abundance and species richness during video-cine transect surveys, 1986 - 2001. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Year	Abundance			Species		
	Winter	Summer	Total	Winter	Summer	Total
1986	2275	2133	4408	10	16	17
1988	2559	3225	5784	6	15	15
1990	813	4505	5318	10	16	18
1991	3539	5348	8887	19	15	21
1992	5578	4716	10294	18	17	22
1993	6930	2712	9642	19	15	21
1994	3168	7833	11001	17	24	24
1997	ns	2198	2198	ns	18	18
1998	ns	2380	2380	ns	19	19
1999	839	5033	5872	16	19	23
2000	2802	6336	9138	17	22	25
2001	4349	1282	5631	24	19	28
Mean	3285	3975	6713	16	18	21

ns = not sampled

\* Adjusted to exclude large school of Pacific sardines in summer (approximately 150,000 individuals)

As of 2001, at least 51 fish species have been recorded during the video-cine transects (Appendix H-4). Three species in 2001, the Pacific angel shark (*Squatina californica*), cabezon (*Scorpaenichthys marmoratus*), and California barracuda (*Sphyraena argentea*), were new to the video survey record. These species, although not seen during past video surveys, are common residents of southern California. Pacific angel shark was severely impacted by a commercial fishery that began in 1977 at about 150 kg and reached 300,000 kg in 1984. They are found in a wide variety of habitats from 3 to 200 m and are typically seen throughout the year; they range from Chile, and the Gulf of California to Alaska (Love 1996). Although seen only at the discharge in winter, cabezon are frequent visitors to reefs from Alaska to central Baja. The California barracuda is typically found in late-spring to early summer as they tend to follow the warmer water from Baja to southern California. All species observed in 2001, excepting orangethroat pikeblenny (*Chaenopsis alepidota*), are common to the Southern California Bight and most are residents or frequent visitors to King Harbor (Stephens 1977). The orangethroat pikeblenny is not common in southern California, typically ranging from Anacapa Island to Banderas Bay, Mexico, but are common in sandy worm tubes near the Units 7&8 discharge (having occurred in nine of the 22 surveys beginning in 1986 and continuing in 2001) and a few places at Catalina and Anacapa Islands (Appendix H-4, Eschmeyer 1983, Curtis pers. obs.).

Total fish abundance in 2001 was below the mean abundance, but was intermediate in the long-term record (Appendix H-4). Abundance was notably low in 1997 and in 1998; abundances during these years were only about 60% of the mean of summer abundances for the preceding years, and they were the lowest abundances observed since 1986. The probable reason for the low abundance in 1997 and in 1998 was that the largest oceanographic disturbance of the century, an El Niño, took place in late-1996 and continued into the spring of 1998. It was immediately followed by a La Niña, a cold water disturbance. The warm waters that accompany El Niños and the cold waters that follow in a La Niña are known to shift centers of population up the coast, resulting in atypical species groupings (McGowan 1985). Many of the forage fishes moved north or offshore, resulting in reductions of those species and the marine life that forage on them. The large increase in these populations noted in 2000 is indicative of how fast conditions can return to normal following these oceanographic temperature excursions.

Although differences in species composition at the three stations were apparent, only one species, the orangethroat pikeblenny has shown a consistent preference for the discharge area over the control area. Orangethroat pike blenny is a southern species at the limit of its range in southern California. It evidently prefers the warmer waters associated with the discharge. Several species are found in greater abundance at the discharge because of demonstrated feeding advantages at the site. These have included schooling species such as Pacific sardines (*Sardinops sagax*), shiner perch (*Cymatogaster aggregata*), topsmelt, jacksmelt, slough anchovy (*Anchoa deliciosa*), sargo, and blacksmith; they also may include other species both schooling and individuals that are attracted by the warmer waters at the discharge such as yellowtail (*Seriola dorsalis*), California bonito, Pacific mackerel (*Scomber japonicus*), and zebra perch (*Hermosilla azurea*). Other species such as rock wrasse, black perch, kelp bass (*Paralabrax clathratus*), señorita, California sheephead (*Semicossyphus pulcher*), opaleye (*Girella nigricans*), pile perch, garibaldi (*Hypsoprops rubicundus*), giant kelp fish (*Heterostichus rostratus*), and spotted sand bass (*Paralabrax maculatofasciatus*), and several bottom dwelling species, such as spotted turbot (*Pleuronichthys ritteri*), C-O turbot (*Pleuronichthys coenosus*), diamond turbot (*Hypsopsetta guttulata*), and round stingray (*Urolophus halleri*) apparently have no strong preference for any one area of the harbor as evidenced by the recordings at different stations over the years. Of all the species with greater than one occurrence, only California scorpionfish (*Scorpaena guttata*), blackeye goby (*Coryphopterus nicholsii*), California lizardfish (*Synodus lucioceps*), rubberlip surfperch (*Rhacochilus toxotes*), and painted greenling (*Oxylebius pictus*) have been seen only at the control station, probably because of their preference for rocky habitat.

Blacksmith was the most abundant species in 2001; it is one of three species (along with señorita and kelp bass) that has been found in all of the 22 winter and summer surveys. It has been the most abundant species in 16 of the 22 surveys and second most abundant in the five of the other six surveys. It has consistently been more abundant at the discharge where the fish are observed feeding in the discharge waters. Although blacksmith are found throughout the harbor, typically it is the juveniles that are noted along the breakwater. In 2001, most of the individuals seen at the discharge and at the control breakwater stations were adults. Blacksmith is a mid-water, temperature-tolerant species ubiquitous in King Harbor, due primarily to the presence of warm-water effluent and associated prey items entrained and discharged by Units 7&8 (Stephens 1977) and, in part, to the presence of the discharge structure itself which acts as an artificial reef (Helvey and Dorn 1981).

Sargo (*Anistremus davidsonii*) was second in abundance in 2001, but was fifth in 2000, third in 1999, and sixth in the long-term record. It is a schooling species often found in shallow water near bottom and is closely associated with the margins of rocky reefs. Sargo feed on invertebrates such as amphipods, shrimp, isopods, and occasionally on kelp scallops (Love 1996). All of these are common prey found on and near rocky riprap structures such as are found in King Harbor. In the 2001 video survey, sargo showed a preference for shallow subtidal rocky substrate, as they were noted at the discharge structure, the inshore riprap area of the discharge, and on or near the riprap of the breakwater at the control station.

Señorita was the third most abundant species in 2001. Although señorita has been present in all 22 surveys and is a member of the core group of species, its abundance since 1994 had been relatively low. Señorita is at its northern range limit, and had probably not recruited well during the last several years because of the La Niña which brought unusually cold waters to southern California. As temperatures have returned to normal, so it appears the señorita populations are returning to a normal level. Jacksmelt was the fourth most abundant species in 2001; it was third in abundance in 2000 and fifth in the overall record. Its congener topsmelt was 10<sup>th</sup> in abundance in 2001, but was the most abundant species in 1997, 1998, and 2000, and was second in 1999. During the 2001 survey, topsmelt were observed only at the discharge station and only in summer. Both species are common throughout the year in impingement catches at other nearby power station

intakes (MBC 2000). All of the individuals observed were feeding within the thermal effluent. Their presence at the discharge appears to be a matter of chance, as they are a common harbor and open coast nearshore species. However, they probably preferentially utilize the Units 7&8 thermal discharge, encountered by chance, to feed on entrained planktonic prey (Stephens 1977). They are normally seen just below the surface of the water and, although undoubtedly present elsewhere in the harbor, they are not as readily visible to the camera as they are when feeding in the discharge plume.

Pacific sardines were not observed in 2001, but they were the second highest in abundance in 2000 as they were in 1992; a very large school was recorded in 1990. This species is ranked first in the long-term record, but they are not a common resident of the harbor as they have occurred in only three of the 22 video-surveys, and only at the discharge station where the occurrence of 150,000 individuals made them the most abundant species overall. Blacksmith was fourth highest in abundance in 2000, was ranked first in 1999, and is second in the long-term record. It was found at all stations during the 2000 video-cine transect surveys. However, the majority of the abundance (97%) occurred at the two discharge stations.

Shiner perch were not observed in 2001, although they were sixth in abundance in 2000, third in 1999, and seventh in the long-term record. Shiner perch were observed only at the discharge (Stations C1 and C2) in summer 2000; they were also observed in 1999 in a single large school in the same area. Shiner perch have been observed only periodically in past surveys, but because of their schooling behavior, are very abundant when they are observed (Appendix H-4). They have frequently been entrained at Units 7&8. Abundance of shiner perch impinged varies from year to year (Appendix I-8), probably due to chance encounters of schools with the intake. Shiner perch are seasonal residents of the harbor and have been observed in large concentrations near the Units 7&8 discharge (Stephens 1977) and near the Units 7&8 intake by MBC biologist-divers.

Rock wrasse was fifth in 2001 and are normally found near the breakwater or other riprap in the harbor, although substantial numbers of rock wrasse were found near the warm water discharge during the 2000 survey. Pile perch was eighth and black perch was ninth in the 2001 survey and were 10<sup>th</sup> and 11<sup>th</sup>, respectively, in the long-term record. These species are also perennial inhabitants found year round in the harbor. Barred sand bass and kelp bass were observed primarily on rocky portions of the riprap that form the breakwaters. Kelp bass has been observed in all 22 surveys, black perch and pile perch in 21 surveys, and rock wrasse in 19 surveys, indicating they are all members of the core group of species that comprise the typical population of King Harbor. These are diurnal species associated with reefs and underwater structures (Love 1996). Their distribution was probably due to the presence of the medium-to-high relief structure rather than the heated discharge.

The macroinvertebrate community found within King Harbor was diverse, but not particularly abundant in 2001. Nine species were noted in the video record, only three of which were found at both the discharge and control areas. All three of the most abundant species were particularly abundant at the discharge during winter and summer. Wavy top snail was not noted and the other two species were not abundant at the control area.

Differences between the winter and summer abundances of fish were likely the result of many of the species preference for the warmer water present at the Units 7&8 discharge structure during winter. In summer, the temperature difference between the areas is much reduced thereby eliminating this advantage. It has been shown that the discharge and riprap structures within the harbor and the heated effluent provide a variety of spatial niches and foraging opportunities, resulting in a varied and rich fish and macroinvertebrate community. The presence of a thermal discharge during the winter increases these opportunities, thereby increasing the population surrounding the discharge structure. In general, the fish and macroinvertebrate communities remain

abundant, healthy, and diverse, indicating the absence of a detrimental effect on the fauna in the harbor from the discharge of heated effluent during operation of the generating station.

### **Impingement**

Impingement surveys during the 2001 sample year (1 October 2000 to 30 September 2001) at Units 5&6 and Units 7&8 indicated that 57 fish species, representing over 9,200 individuals and weighing over 1,700 kg, were taken. The surveys covered 19 heat treatments and an estimated 337 flow days of normal operation at Units 5&6 and 352 days of normal operations at Units 7&8. In addition, an estimated 3,700 motile macroinvertebrates, weighing almost 1,400 kg and representing at least 29 species, were taken.

Of the 57 species of fish that occurred, all are common species in impingement catches and have occurred at one or both of the different screenwells at the generating station in the past. Fish and macroinvertebrate species, which live near or occasionally visit the intake structures, are, at times, inadvertently entrained by the flow of cooling water into the intake structure. Several species of fish are known to exhibit positive rheotaxis to this inward flow of water (Helvey and Dorn 1981). Feeding on plankton entrained by the flow appears to be the primary reason for this behavior, although several non-planktivorous species are also known to exhibit similar behavior (Helvey and Dorn 1981). Intake water velocities, depending on position around the intake structure opening, vary from 0.15 to 1.2 meters per second (McGroddy et al. 1981). Fish feeding in one area of low flow and swimming into an adjacent high current area may be entrained. Swells impart an additional velocity (which may be substantial during periods of high swell) to these currents and may substantially increase loss as evidenced by increased impingement during these periods (Johnson et al. 1976). As shown by hourly impingement surveys and modeling studies of intakes, most entrainment occurs at night (Muench et al. 1977, SCE unpubl. data). Impingement has also been shown to increase during heavy storm run off. The common unifying factor of the observed behavioral phenomena is the decrease in ambient light levels and, therefore, visibility. Without visual cues, fish cannot sense the currents encountered at the intake and are easily entrained.

**Fish.** Most of the fish species which were very abundant overall were not present at Units 5&6. Several factors account for this difference in catch. Intake velocities at full flow are lower at Units 5&6 than at Units 7&8. Therefore, fish are less likely to be entrained in the flow at the Units 5&6 intakes. The lack of strong current flow also makes the Units 5&6 intakes less attractive to fish such as blacksmith and other species which utilize the current flow to feed (Helvey and Dorn 1981). Further, there is minimal riprap surrounding the intakes for Units 5&6. Helvey and Smith (1985) concluded that diversity was influenced by the amount and degree of riprap structure surrounding the intakes in King Harbor and other areas. The diversity of the rocky riprap structure at the Units 7&8 intake provides a variety of niches which are not available at the in-harbor intakes located on a silty bottom, well within the confines of the harbor. Species abundance near these intakes has been noticeably less than that observed at the Units 7&8 intake (M. Curtis pers. obs.). The species taken almost uniquely from this area are common harbor residents or are usually associated with shallow water habitat.

The most abundant species in 2001 was queenfish; it ranks third in the long-term record, but has been ranked number one in three of the last five years. It is considered a habitat generalist and is very abundant over soft substrate such as that present offshore of the King Harbor area (Allen 1982, Allen 1985). This nocturnal species schools during the day and is abundant near the intake and discharge structures at night (Curtis, pers. comm.). During day-night impingement studies at San Onofre Nuclear Generating Station, impingement of queenfish was shown to be much greater at night (SCE 1986).

Two other schooling species, sargo and shiner surfperch, were second and third in abundance in 2001, but 12<sup>th</sup> and fourth, respectively, in the long-term record. Sargo was second and was observed in the harbor both in the winter and summer video surveys in large numbers. Although, it is frequently seen in the harbor, it has only been in the top 10 in abundance one other time in the 11 year record, in 1998 when it was sixth in abundance. Shiner perch was sixth in 2000, but was first in 1999, and 1996; it is present regularly among the impinged species from King Harbor, and ranks fourth overall since 1991 (Table 17). Shiner perch are consistently taken in the spring as they move inshore to give birth and, in doing so, pass near the intake structure (Johnson et al. 1976). Surfperch are live-bearers and, because they are slower and encumbered during this phase, they are particularly susceptible to the strong current flows near the intakes, especially during periods of high swell (Johnson et al. 1976).

The fourth and fifth most abundant species, black perch and northern anchovy, have occurred every year, and ranked eighth and ninth, respectively, overall, since 1991. Black perch are typically found around rocky reefs and kelp beds, and are abundant from the surf zone out to 80 ft deep (Love 1996). They tend to stay close to the bottom and feed on crabs and small invertebrates. They are an important part of the sportfishery, usually caught from piers and jetties, and are part of the commercial fishery (Love 1996). Northern anchovy are frequent visitors to King Harbor and are probably entrained as they encounter the intake structure during night time feeding activities; they form dense schools during the day that break up at night probably to feed.

**Table 17. The 20 most abundant fish species impinged during heat treatment and normal operations, 1991 - 2001. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	Year											Percent	
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Total	Total
Pacific sardine	3	36334	1951	228	68	1	87	81	67	305	86	39210	29.7
blacksmith	7960	1282	18145	497	1790	402	1676	632	132	91	329	32935	25.0
queenfish	3715	2716	485	655	166	150	2883	156	261	939	1735	13860	10.5
shiner perch	1343	1094	31	94	816	1318	56	20	781	130	994	6677	5.1
kelp bass	856	475	466	147	357	203	408	491	43	94	114	3654	2.8
California scorpionfish	469	317	237	274	1006	399	115	49	52	205	529	3652	2.8
salema	2138	-	8	661	371	-	72	204	34	51	45	3584	2.7
black perch	234	116	271	34	82	363	425	63	279	144	881	2893	2.2
northern anchovy	552	800	97	35	98	34	176	19	2	215	839	2868	2.2
black croaker	161	376	67	288	92	25	148	686	8	53	202	2107	1.6
barred sand bass	258	210	221	167	265	64	127	236	24	44	147	1764	1.3
sargo	167	72	46	37	38	7	94	158	1	39	1058	1717	1.3
giant kelpfish	175	161	26	132	116	79	49	10	77	38	517	1381	1.0
pile perch	197	274	241	46	45	23	258	51	172	7	62	1376	1.0
topsmelt	24	10	10	2	52	10	1120	48	40	-	8	1325	1.0
plainfin midshipman	723	17	48	37	243	3	34	24	-	30	25	1185	0.9
thornback	406	128	39	14	68	122	1	58	38	-	29	903	0.7
jacksnelt	-	9	68	-	31	7	273	28	-	-	475	892	0.7
rainbow seaperch	168	93	229	40	55	34	107	32	2	92	32	885	0.7
kelp perch	336	412	42	1	3	42	7	2	-	-	-	845	0.6
<b>Survey Totals:</b>													
Number of individuals	21748	46086	23312	3820	6478	3533	9010	3406	2276	2978	9256	131904	
Number of species	67	56	53	56	51	47	47	58	43	38	57	101	

Population structures were analyzed for several abundant fish species to determine if the intakes in and near the harbor were preferentially entraining certain size classes. Queenfish mature at about one year and approximately 110 mm SL (DeMartini and Fountain 1981). Most of the queenfish taken in 2001 were less than 80 mm, and thus were Age-0 fish. Sargo mature at about 178 mm at two years (Love 1996). A broad range of size classes was impinged in 2001, but most were larger than 180 mm SL, suggesting they were reproductively mature. Some barred sand bass mature at two years and about 178

mm, while all are mature after five years (about 267 mm) (Love 1996). Most of the barred sand bass impinged in 2001 were likely Age=2 to Age=5 fish.

Because very few fish were entrained and impinged during heat treatments and normal operations occurring at Units 5&6 in 2001, a meaningful comparison could not be made to the Units 7&8 impingement catches. As noted, the Units 5&6 intakes are located within the confines of the harbor and are relatively shallow (25 ft) with little adjacent riprap. Of the 11 species taken at Units 5&6, most are relatively slow moving demersal fish that associate with reef and rock structures, and live in or around the intake structure, with only a few individuals of these species occasionally having strayed into the influence of the Units 5&6 intake currents.

The Units 7&8 intake is located at the entrance of the harbor, 20 m from the end of the breakwater, at a depth of approximately 50 ft, at the mouth of a submarine canyon. It is surrounded by a rocky riprap that extends 10 m out from the intake structure into a distinctly coarse-sand substrate. Most of the species entrained are common on or near high-relief rocky features, such as the intake structure, or are mid-water schooling species which forage along the sand bottom offshore. With slight variations, the composition of the impingement samples from Units 7&8 has been very similar since 1990, the first year impingement data was reported.

Data from 1975 through 2001 indicated that yearly impingement biomass decreased to its lowest level ever in 1994, then fluctuated back up to the current biomass (Table 18). The highest impingement totals were approaching 20,000 kg in 1975 and more than 26,000 in 1976 (Johnson et al. 1976). Biomass went to one-fifth that in 1977. The reason for the very sharp decline is unknown, however increasing ocean temperatures and a long-term decline in zooplankton biomass, especially in the 1970s, are possible factors for these declines (Allen and Moore 1996). Cartilaginous fish, especially spiny dogfish (*Squalus acanthias*) and Pacific electric ray in 1975 and 1976 accounted for one-third the biomass but only 1% of the abundance (4,677). It is also of note that fish catches as printed in the Los Angeles Times sports catch increased dramatically in Santa Monica Bay (from about 500,000 in 1974 to about one million in 1975 (MBC unpublished data), possibly indicating some bay wide changes. Northern anchovy were particularly abundant during those two years accounting for 7% of the biomass (7,000 kg). Queenfish and white croaker accounted for an additional 5% or more than 5,000 kg, while shiner perch alone accounted for 2.5% or almost 2,500 kg. After the sharp decline, biomass then stabilized and remained similar (mean near 5,000 kg) from 1977 through 1985, and then rapidly declined to 1,365 kg in 1988. In the ensuing years, biomass fluctuated but stayed above 1,000 kg before quickly declining to less than 300 kg in 1994, then returning to above 500 kg. The primary reason for the decline since 1988 is a reduction in the number of circulating water pumps operating and, therefore, the strength of the current at the intake. AES Redondo Beach L.L.C. generating station operated at only 20 to 40% of capacity from 1988 to the present, and circulators have operated at a reduced capacity, and intermittently, during that

**Table 18. Biomass (kg) of fish impinged during heat treatment and normal operations, 1975 - 2001. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Year	Normal Operations	Heat Treatments	Total
1975	15757.69	3623.58	19381.27
1976	24568.39	1752.83	26321.22
1977	3988.8	129.26	4118.06
1978	6000.54	245.13	6245.67
1979	5088.65	1354.17	6442.82
1980	2512.43	2339.55	4851.98
1981	2028.98	2523.90	4552.88
1982	3406.47	1327.76	4734.23
1983	3206.73	1099.71	4306.44
1984	2103.39	2107.27	4210.66
1985	2269.98	1871.83	4141.81
1986	1841.43	1299.34	3140.77
1987	1769.94	1328.90	3098.84
1988	873.11	492.17	1365.28
1989	1542.94	351.48	1894.42
1990	1821.50	1002.60	2824.10
1991	2781.25	631.96	3413.21
1992	638.10	672.83	1310.93
1993	491.66	547.05	1038.71
1994	69.59	214.87	284.47
1995	428.56	241.40	669.96
1996	76.62	254.51	331.13
1997	716.23	415.63	1131.87
1998	216.84	347.04	563.88
1999	597.19	102.31	699.50
2000	365.90	127.10	492.99
2001	910.64	825.55	1736.19
Mean	3187.91	1008.51	4196.42

period. However, it is evident that other unknown factors have also affected total impingement, as biomass has varied considerably since 1988, even though flow rates had not changed substantially. Environmental conditions less favorable to temperate fish species (such as the occurrence of strong El Niño events in 1977, 1982-83, 1991-1992, 1997-1998, and equally strong La Niñas in 1989 and 1998-99) have reoccurred frequently in the past 20 years. Both the advent and the waning of an El Niño and the rebound effects of cold water La Niña years have been shown to change centers of fish distribution, resulting in the enhancement of some species and displacement of others (Bailey and Incze 1985).

**Macroinvertebrates.** The macroinvertebrate populations were different at both Units 5&6 and Units 7&8 primarily due to differing flow rates, bottom structure, and location of the two intakes. Both abundance, biomass, and species composition was similar to those seen in surveys from previous years (MBC 1990-1994, 1997-1999). Abundances of spiny lobsters increased greatly over that seen in prior years, with a reduction in abundances of smaller crab and shrimp species commonly seen since 1990. This change caused an increase in biomass, due to the large weight of individual spiny lobster. This species is common along the King Harbor breakwater and it is likely that the increase in abundances reflect larger populations in the area. Most of the individuals seen during impingement surveys are captured alive, and returned to the ocean.

The occurrence throughout the Southern California Bight of most of the species taken during impingement sampling and the lack of any clearly definable evidence that the impinged fish and invertebrate communities are unique indicate that the Redondo Beach generating station is not adversely affecting the fish and macroinvertebrate populations.

## CONCLUSIONS

Water quality parameters measured in 2001 in King Harbor and Santa Monica Bay were all within ranges recorded in previous surveys. As would be expected, surface temperatures were higher in the harbor than offshore, and surface temperatures in the study area increased slightly during the afternoon in winter and summer, likely the result of solar warming. Dissolved oxygen (DO) concentrations were slightly higher offshore than in the harbor during both surveys, and slightly higher concentrations recorded in the afternoon probably resulted from increased primary production. Hydrogen ion concentrations (pH) were fairly uniform throughout the water column, and slight subsurface increases in winter also were the likely result of increased primary production. All salinity values were within the range of values considered normal in southern California. The only detectable effects from the operation of the Redondo Beach generating station were slight increases in temperature at stations nearest the Units 5&6 and Units 7&8 discharges in winter, and at stations nearest the Units 7&8 discharge in summer.

Sediments in the study area in 2001 were composed primarily of sand, with lesser amounts of silt and clay. Sediments were generally finer in the 2001 survey than in past surveys. Among King Harbor stations, sediments at Station B3 (located at the entrance to King Harbor) were coarsest, and sediments from Station B2 were finest. Sediments at Station B2 had the second greatest amounts of silt and clay historically recorded in the study area. Results suggest sediments are primarily affected by area-wide and localized oceanographic conditions, such as prevailing nearshore currents, swells, and wave action. The discharges from the Redondo Beach generating station do not appear to be adversely affecting sediment composition in the study area.

In 2001, as in previous studies, the highest concentrations of chromium, copper, and zinc were found within King Harbor; unlike previous surveys, nickel was found in higher concentrations offshore, at Station B6. Offshore, metal levels were also consistently higher than levels noted since 1990. Highest sediment metal levels were generally detected at Station B2, where sediments were finest. Levels were generally higher but more consistent with past surveys than with 2000 when unusually low levels of metals were detected in King Harbor. The distribution of metals in the study area appeared to be linked

to localized sediment grain size and sources unrelated to the generating station discharges. Most values, except nickel at Station B6, observed in the present study were below levels determined to have potentially toxic effects. The 2001 results show no indication that the operation of the generating station has had an appreciable effect on sediment metal concentrations.

Mussel tissue collected at the Units 7&8 discharge, and the pier reference site in 2001 contained detectable concentrations of copper and zinc. Chromium and nickel were not detected at any sampling station. Copper levels decreased at both the harbor station and the pier reference station from 2000 levels. Zinc concentrations were the lowest recorded since 1990 for the reference station and second lowest for the harbor station. The recorded levels of zinc and copper in 2001 were within the range recorded in past NPDES surveys and CSMW and NOAA studies. The operation of the Redondo Beach generating station does not appear to be adversely affecting metal levels in the study area.

The infaunal communities at the King Harbor stations were more abundant, speciose, and different in composition from those offshore in Santa Monica Bay. The communities were similar among stations within the harbor, with the exception of additional species at the Units 7&8 discharge and at the harbor entrance where sediments were coarse and contained mollusk and barnacle shell fragments. The community dominants were typical of harbor environments with poorly sorted sediments. In Santa Monica Bay, where sediments were sandy and well sorted, the communities were similar among the four stations, and were typical of the nearshore habitat in the Southern California Bight. The abundant species in 2001 have been among the core group of species found in the study area since 1978. Influence from the discharges was apparent only at Station B1, where turbulence from the discharge appear to maintain coarse sediments containing an abundant and diverse infauna community.

The 2001 video-cine surveys of the fish populations surrounding the Units 7&8 discharge and the breakwater indicated a similarity in species richness and fish abundances when compared to the long-term means of past surveys. The previous survey year followed oceanographic perturbations including an El Niño and the recent La Niña phenomena which have been shown to shift fish populations. In spite of this, the populations recovered strongly in 2000, and in 2001 the presence of the same core group of species continued. This year to year stability indicates the fish and macroinvertebrate populations of King Harbor remain stable, healthy, abundant, and diverse.

The results of the 2001 impingement surveys of the fish populations indicated that there is a long-term stability in the species composition. Continued presence of the same core group of species, as evidenced by impingement data from more than 20 years, indicated that the generating station is not appreciably impacting the fish and macroinvertebrate populations of King Harbor, as species therein, remain healthy, abundant, and diverse.

The overall results of the 2001 NPDES monitoring program indicated that operation of the AES Redondo Beach L.L.C. generating station had no detectable effects on the beneficial uses of the receiving waters.

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## **APPENDIX A**

### **Receiving water monitoring specifications**

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AES Redondo Beach, LLC  
Redondo Generating Station  
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Order No. OO-085  
CA0001201

#### IV. RECEIVING WATER MONITORING

##### A. Regional Monitoring Program

1. Pursuant to the Code of Federal Regulation [40 CFR §122.41(j) and §122.48(b)], the monitoring program for a discharger receiving a National Pollutant Elimination System (NPDES) permit must determine compliance with NPDES permit terms and conditions, and demonstrate that State water quality standards are met.
2. Since compliance monitoring focuses on the effects of a point source discharge, it is not designed to assess impacts from other sources of pollution (e.g., nonpoint source runoff, aerial fallout) nor to evaluate the current status of important ecological resources on a regional basis.
3. Several efforts are underway to develop and implement a comprehensive regional monitoring program for the Southern California Bight, in particular the Santa Monica Bay. These efforts have the support and participation from regulatory agencies, dischargers and environmental groups. The goal is to establish a regional program to address public health concerns, monitor trends in natural resources and nearshore habitats, and assess regional impacts from all contaminant sources. In general, the goal is a more efficient monitoring program that can be used for both compliance and regional bight-wide assessments.
4. The compliance monitoring programs for the AES Redondo Beach, L.L.C., and other major ocean dischargers will serve as the framework for the regional monitoring program. However, substantial changes to these programs will be required to fulfill the goals of regional monitoring, while retaining the compliance monitoring component required to evaluate the potential impacts from NPDES discharges.
5. Two pilot regional monitoring programs for the Southern California Bight were conducted in 1994, and again in 1998. The pilot monitoring allowed the USEPA and the Regional Board to test an alternative sampling design that incorporates aspects of regional monitoring into current compliance programs. These pilot programs were designed by USEPA, the State Water Resources Control Board, and three Regional Water Quality Control Boards (Los Angeles, Santa Ana, and San Diego) in conjunction with the Southern California Coastal Water Research Project and participating discharger agencies.

The pilot regional monitoring programs included the following components: microbiology, water quality, sediment chemistry, sediment toxicity testing, benthic infauna, demersal fish and bioaccumulation.

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6. The two pilot regional monitoring programs were funded, in large part, by resource exchanges with the participating discharger agencies. During the year when pilot regional monitoring was scheduled, USEPA and this Regional Board eliminated portions of the routine compliance monitoring programs for that year, while retaining certain critical compliance monitoring elements. A certain percentage of the traditional sampling sites were also retained to maintain continuity of the historical record and to allow comparison of different sampling designs. The exchanged resources were redirected to complete sampling within the regional monitoring program design. Thus, the dischargers' overall level of effort for 1994 and 1998 pilot programs remained approximately the same as the compliance monitoring programs.

Future regional monitoring programs may be funded in a similar manner. Thus, revisions to the routine compliance monitoring program will be made under the discretion of the USEPA and this Regional Board as necessary to accomplish the goal; and may include resource exchanges.

7. The results of the pilot programs are being evaluated and will be used to redesign the future pilot monitoring program and to develop a comprehensive regional monitoring program for the Southern California Bight. At the same time, the monitoring programs conducted by other dischargers and agencies will be integrated into this regional program. If predictable relationships among the biological, water quality, and effluent monitoring variables can be demonstrated, it may be appropriate to decrease the sampling effort. Conversely, the monitoring program may be intensified if it appears that the objectives cannot be achieved through the existing compliance monitoring program.
8. The Receiving Water Monitoring Program in this Order is similar to that in the 1994 NPDES permit. Until such time when a regional monitoring program is developed (projected for 2002), and with the exception of future pilot regional monitoring program sampling periods, the Discharger shall perform the analyses described in the following monitoring program.

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## B. Receiving Water Monitoring

The receiving water monitoring program shall consist of periodic biological surveys of the area surrounding the discharge, and shall include studies of those physical-chemical characteristics of the receiving waters which may be impacted by the discharge.

Location of Sampling Stations (see Attached Figures 1 and 2):

1. Receiving water stations shall be located as follows:
  - a. Station RW1 - at the outfall terminus for Units 7 and 8 (within King Harbor).
  - b. Station RW2 - located on an arc 500 feet from the point of discharge for Units 7 and 8, in a direction of 292 degree T.
  - c. Station RW3 - on an arc 500 feet from the point of discharge for Units 7 and 8, half the distance between RW2 and RW4.
  - d. Station RW4 - 500 feet from station RW1, on the intake conduit centerline.
  - e. Station RW5 - on an arc 500 feet from the point of discharge for Units 7 and 8, half the distance between RW4 and RW6.
  - f. Station RW6 - on an arc 500 feet from the point of discharge for Units 7 and 8, in a direction of 150 degree T.
  - g. Station RW7 - on an arc 1,325 feet from the point of discharge for Units 7 and 8, in a direction of 292 degree T.
  - h. Station RW8 - on an arc 725 feet from the point of discharge for Units 7 and 8, in a direction of 292 degree T.
  - i. Station RW9 - at the navigation bell buoy outside of King Harbor.
  - j. Station RW10 - directly between the discharge points for Units 5 and 6 (offshore of Redondo Beach).
  - k. Station RW11 - 1,000 feet downcoast of station RW10, at the same depth as RW10.
  - l. Station RW12 - directly offshore of Station RW11, at a depth of 40 feet.
  - m. Station RW13 - directly offshore of station RW14, at a depth of 40 feet.

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- n. Station RW14 - 1,000 feet upcoast of station RW10, at the same depth as RW10.
- o. Station RW15 - 1,000 feet inshore of station RW10, along the centerline of the discharge conduits.
- p. Station RW16 - 4,400 feet upcoast of station RW10, at the same depth as RW10.

2. Benthic stations shall be located as follows:

- a. Station B1 - directly beneath Station RW1.
- b. Station B2 - directly beneath Station RW8.
- c. Station B3 - directly beneath Station RW4.
- d. Station B4 - directly beneath Station RW10.
- e. Station B5 - directly beneath Station RW11.
- f. Station B6 - directly beneath Station RW14.
- g. Station B7 - directly beneath Station RW16.

3. Video or cine transects shall be established as follows:

- a. Station C1 - parallel to and 100 feet east of the discharge conduit for Units 7 and 8, initiated at the water edge.
- b. Station C2 - perpendicular to C1 and extending 100 feet on either side of the discharge structure.
- c. Station C3 - parallel to the breakwater adjacent to the intakes for Units 5 and 6.

C. Type and Frequency of Sampling:

- 1. Temperature profiles shall be measured semi-annually (summer and winter) each year at Stations RW1 through RW16 from surface to bottom at a minimum of one meter intervals. Dissolved oxygen levels and pH shall be measured semi-annually at the surface, mid-depth and bottom at each station, at a minimum. All stations shall be sampled on both a flooding tide and an ebbing tide during each semi-annual survey.

Appendix A. (Cont.).

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2. Impingement sampling for fish and commercially important macroinvertebrates shall be conducted at least once every two months at Intake Nos. 001 and 002. Impingement sampling shall coincide with heat treatments.

Fish and macroinvertebrates shall be identified to the lowest possible taxon. For each intake point, data reported shall include numerical abundance of each fish and macroinvertebrate species, wet weight of each species (when combined weight of individuals in each species exceeds 0.2 kg), number of individuals in each 1-centimeter size class (based on standard length) for each species and total number of species are collected. When large numbers of given species are collected, length/weight data need only be recorded for 50 individuals and total number and total weight may be estimated based on aliquots samples. Total fish impinged per heat treatment or sampling event shall be reported and data shall be expressed per unit volume water entrained.

3. Native California mussels (Mytilus Californianus) shall be collected during the summer from the discharge conduit Nos. 001 and 002, as close to the point of discharge as possible, and from Manhattan Beach Pier, for bioaccumulation monitoring. The mussels shall be collected and analyzed as described in Appendix A of the "California State Mussel Watch Marine Water Quality Monitoring Program 1985-86" (Water Quality Monitoring Report No. 87-2WQ). Mussel tissue shall be analyzed for copper, chromium, nickel, and zinc, at a minimum.
4. Benthic sampling shall be conducted annually during the summer at Stations B1 through B7.
  - a. One liter sediment core samples shall be collected by divers at each of the benthic stations for biological examination and determination of biomass and diversity, and for sediment analyses. Four replicates shall be obtained at each station for benthic analyses, and each shall be analyzed separately. A fifth sample shall be taken at each station for sediment analyses and general description.
  - b. Each benthic replicate sample shall be sieved through a 0.5 mm standard mesh screen. All organisms recovered shall be enumerated and identified to the lowest taxon possible. Infaunal organisms shall be reported as concentrations per liter for each replicate and each station. Total abundance, number of species and Shannon-Weiner diversity indices shall be calculated (using natural logs) for each replicate and each station.
- c. Biomass shall be determined as the wet weight in grams or milligrams retained on a 0.5 millimeter screen per unit volume (e.g., 1 liter) of sediment. Biomass shall be reported for each major taxonomic group (e.g., polychaetes, crustaceans, mollusks) for each replicate and each station.
- c. Sediment grain size analyses shall be performed on each sediment sample (sufficiently detailed to calculate percent weight in relation to phi size). Sub samples (upper two centimeters) shall be taken from each sediment sample and

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analyzed for copper, chromium, nickel and zinc. Sediment contaminant data will also be reported normalized against sediment fine grains.

5. Video or cine transect stations shall be occupied and sampled semi-annually during the summer and winter as follows:
  - a. Cine transects shall be filmed (or video taped) by diver operated camera during a swim along the bottom following a 50 meter transect line marked at 1-meter intervals.
  - b. Fishes and macroinvertebrates shall be reported as counts per transect, by species. This number shall be standardized by dividing it by underwater visibility in meters.
  - c. Cine transects shall be conducted only when underwater visibility exceeds 3 meters.
6. The following general observations or measurements at the receiving water and benthic stations shall be reported.
  - a. Tidal stage and time of monitoring.
  - b. General water conditions.
  - c. Extent of visible turbidity or color patches.
  - d. Appearance of oil films or grease, or floatable material.
  - e. Depth at each station for each sampling period.
  - f. Presence or absence of red tide.
  - g. Presence of marine life.
  - h. Presence and activity of the California least tern and the California brown pelican.
7. During the discharge of calcareous material (excluding heat treatment discharge) to the receiving waters, the following observations or measurements shall be recorded and reported in the next monitoring report:
  - a. Date and times of discharge(s).
  - b. Estimate of volume and weight of discharge(s).
  - c. Composition of discharge(s).

Appendix A. (Cont.).

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- d. General water conditions and weather conditions.
- e. Appearance and extent of any oil films or grease, floatable material or odors.
- f. Appearance and extent of visible turbidity or color patches.
- g. Presence of marine life.
- h. Presence and activity of the California least tern and the California brown pelican.

SUMMARY OF RECEIVING WATER MONITORING

<u>Constituent</u>	<u>Units</u>	<u>Station No.</u>	<u>Type of Sample</u>	<u>Minimum Frequency of Analysis</u>
Temperature	°C	RW1-RW16	vertical profile	semi-annually (flood, ebb)
Dissolved oxygen	mg/L	RW1-RW16	vertical profile	semi-annually (flood, ebb)
pH	pH units	RW1-RW16	vertical profile	semi-annually (flood, ebb)
Fish and macro invertebrates	---	Intake Nos. 001 and 002	impingement	bimonthly
Fish and macro invertebrates	---	C1 – C3	cine/video	semi-annually
Mussels	---	Discharge Nos. 001, 002 & Manhattan Beach Pier	tissue	annually
Benthic infauna	---	B1-B7	grab	annually
Sediments	---	B1-B7	grab	annually

The receiving water monitoring report containing the results of semiannual and annual monitoring shall be received at the Regional Board on March 1 of each year following the calendar year of data collection.

Appendix A. (Cont.).

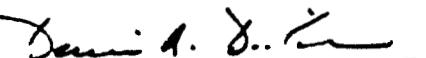
AES Redondo Beach, LLC  
Redondo Generating Station  
Monitoring and Reporting Program No. CI- 0536

Order No. 00-085  
CA0001201

V. STORMWATER MONITORING PROGRAM

The Discharger shall implement the Monitoring and Reporting Requirements for individual dischargers contained in the general permit for Dischargers of Storm Water Associated with Industrial Activities (State Board Order No. 97-030-DWQ adopted on April 17, 1997, section B of Attachment 1). The monitoring reports shall be received at the Regional Board on or before July 1 of each year.

Ordered By:



Dennis A. Dickerson  
Executive Officer

Date:

June 29, 2000

/JRC

Appendix A. (Cont.).

AES Redondo Beach, LLC  
Redondo Generating Station  
Monitoring and Reporting Program No. CI-0536

Order No. 00-085  
CA0001201

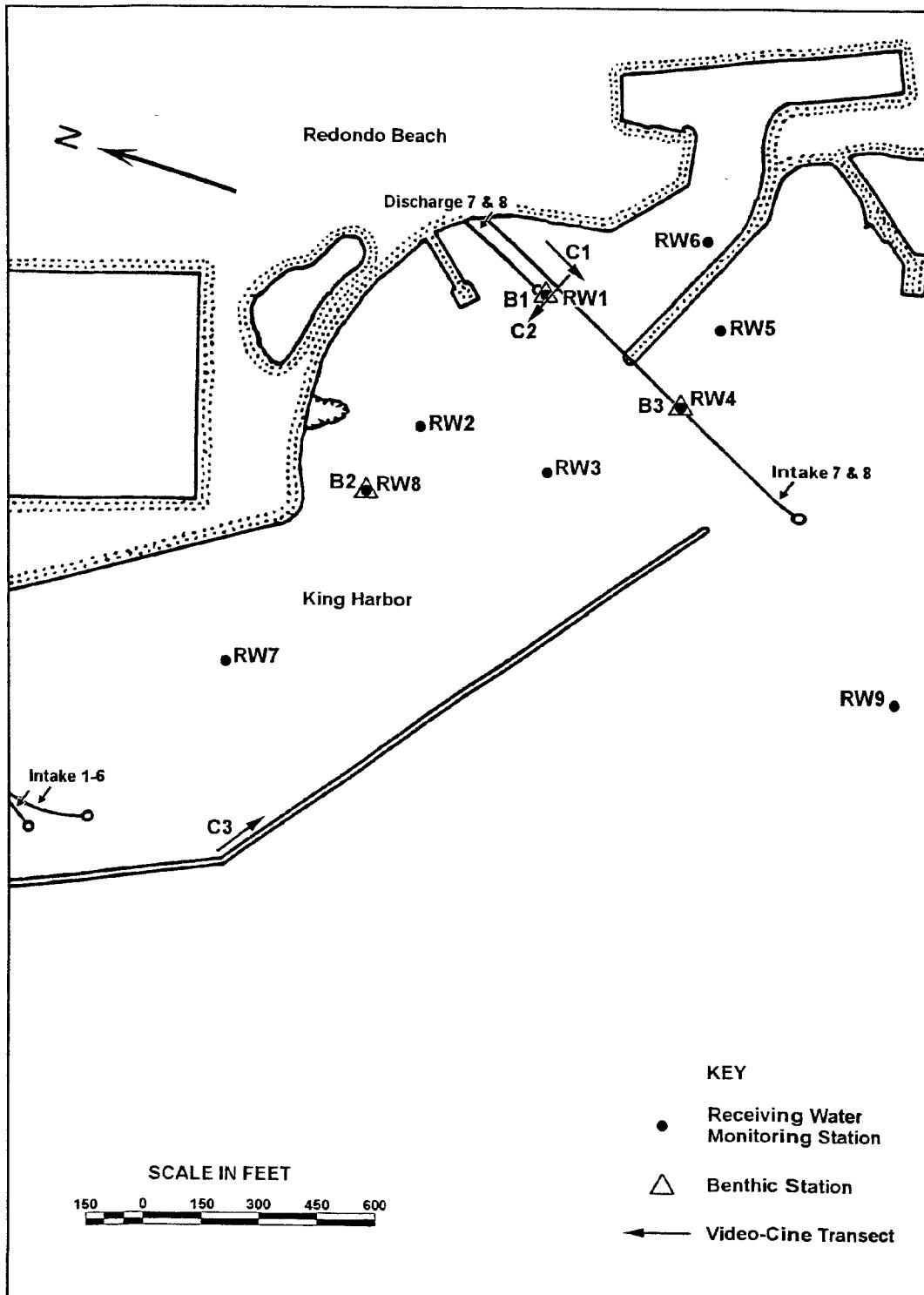


Figure 1. Locations of the sampling stations in King Harbor. Redondo Beach Generating Station.

AES Redondo Beach, LLC  
 Redondo Generating Station  
 Monitoring and Reporting Program No. CI-0536

Order No. 00-085  
 CA0001201

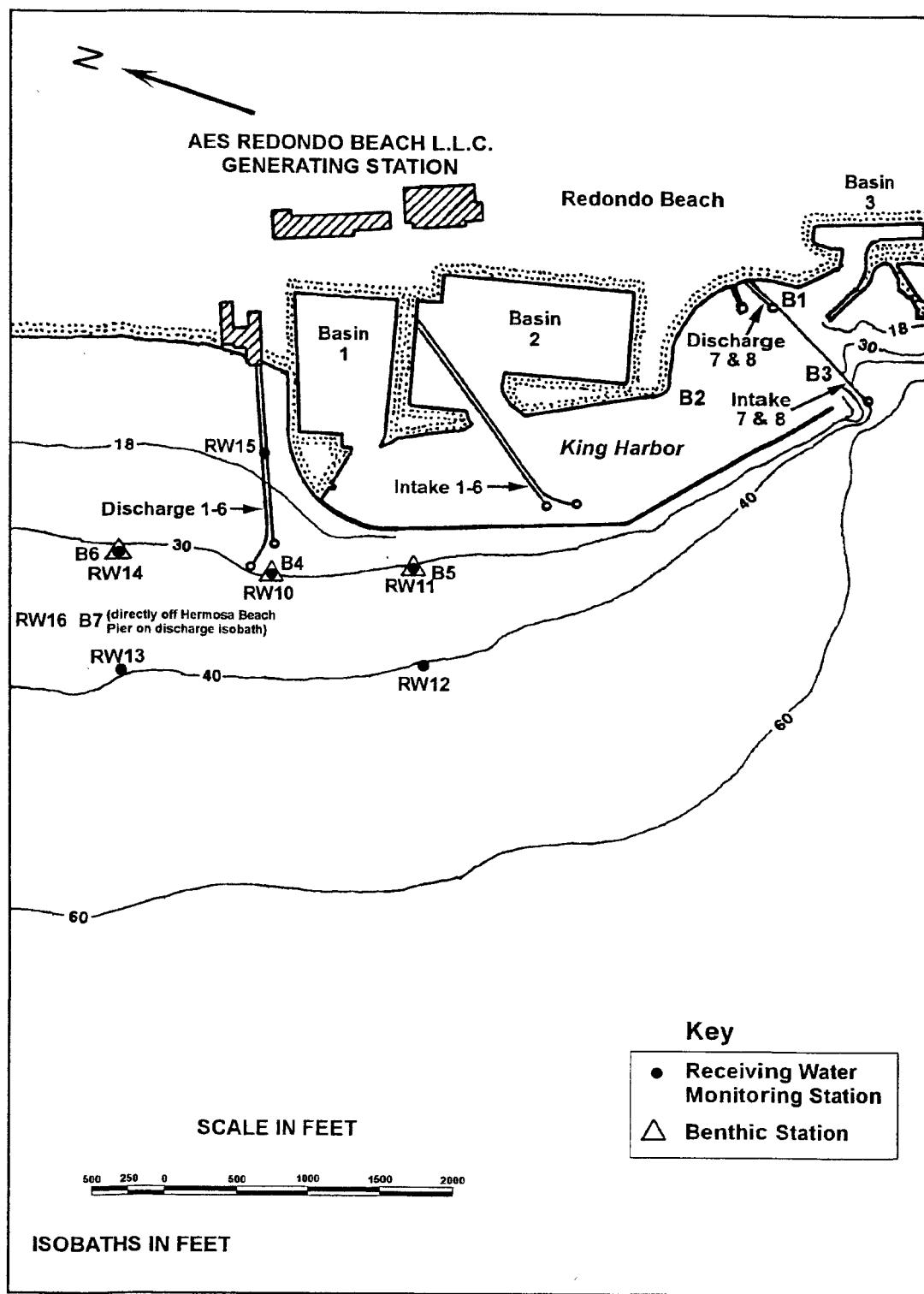


Figure 2. Locations of the sampling stations in Santa Monica Bay. Redondo Beach Generating Station.

## **APPENDIX B**

**Grain size techniques**

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## Appendix B. Grain size techniques.

### Sediment Grain Size Analysis

Analysis of sediment samples for size distribution characteristics are performed using two techniques. Sediments in the gravel size range (> 2.0 mm in diameter) are analyzed using a series of standard sieves having screen openings of 0.5 phi increments (diameter in phi units = -log<sub>2</sub> diameter in mm, or = -ln diameter in mm ÷ ln 2). The sand-silt-clay fraction of sediments [-1 phi through 4 phi (2.0 mm through 0.0625 mm) for sand], [4 phi through 8 phi (0.0625 mm through 0.004 mm) for silt, 8 phi and greater for clay (0.0039 mm and smaller)] is analyzed by laser light diffraction. The sample is suspended in a suspension column and continuously circulated through the laser beam. The laser beam passes through the sample where the suspended particles scatter incident light. Fourier optics collect diffracted light and focus it on to three sets of detectors. A composite, time-averaged diffraction pattern is measured by 126 detectors. Sizes are computed and summed into normal distribution classifications.

Laboratory data from the two methods are mathematically combined and entered into a computer program which calculates and prints size-distribution characteristics and plots both interval and cumulative frequency distribution curves.

Analysis of the plotted cumulative size frequency curves is performed as described by Inman (1952). The median, 5th, 16th, 84th, and 95th percentiles (converted to phi notation) of the sediment distribution curve is used to calculate mean grain size diameter, sorting coefficient, and measures of skewness and kurtosis. Where sediment distribution coincides with a normal distribution curve, the 16th and 84th percentiles represent diameters one standard deviation on either side of the mean. The following formulas are used in the calculations:

1. Mean Diameter ( $M_\phi$ ) is the average particle size in the central 68% of the distribution.

$$M_\phi = (\phi_{16} + \phi_{50} + \phi_{84}) / 3$$

2. Sorting ( $\sigma_\phi$ ) measures the uniformity (or non-uniformity) of particle quantities in each size category of the sediment distribution. A  $\sigma_\phi$  value under 0.35 $\phi$  indicates that particles are very well sorted (i.e. sediments are primarily composed of a narrow range of size classes, or a single size class), while a value of over 4.0 $\phi$  indicates that the sediments are extremely poorly sorted, or evenly distributed among size classes.

$$\sigma_\phi = \frac{\phi_{84} - \phi_{16}}{4} + \frac{\phi_{95} - \phi_5}{6.6}$$

3. Skewness ( $\alpha_\phi$ ) is a measure of the direction and extent of departure of the mean from the median (in a normal or symmetrical curve they coincide). In symmetrical curves,  $\alpha_\phi=0.00$  with limits of -1.00 and +1.00. Negative values indicate the particle distribution is skewed toward larger particle diameters, while positive values indicate the distribution is skewed toward smaller particle diameters.

$$\alpha_\phi = \frac{\phi_{16} + \phi_{84} - 2\phi_{50}}{2(\phi_{84} - \phi_{16})} + \frac{\phi_5 + \phi_{95} - 2\phi_{50}}{2(\phi_{95} - \phi_5)}$$

4. Kurtosis ( $\beta_\phi$ ) is a measure of how far the sediment distribution curve departs from a normal Gaussian shape at its peak. Curves with greater than normal amounts of sediment at their modes will be sharp or leptokurtic ( $\beta_\phi > 1$ ). Those with fatter tails and lower peaks than expected are termed platykurtic ( $\beta_\phi < 1$ ).  $\beta_\phi = 1.00$  for a normal curve. Curve category interpretations are based on Folk (1974).

$$\beta_\phi = \frac{\phi_{95} - \phi_5}{2.44(\phi_{75} - \phi_{25})}$$

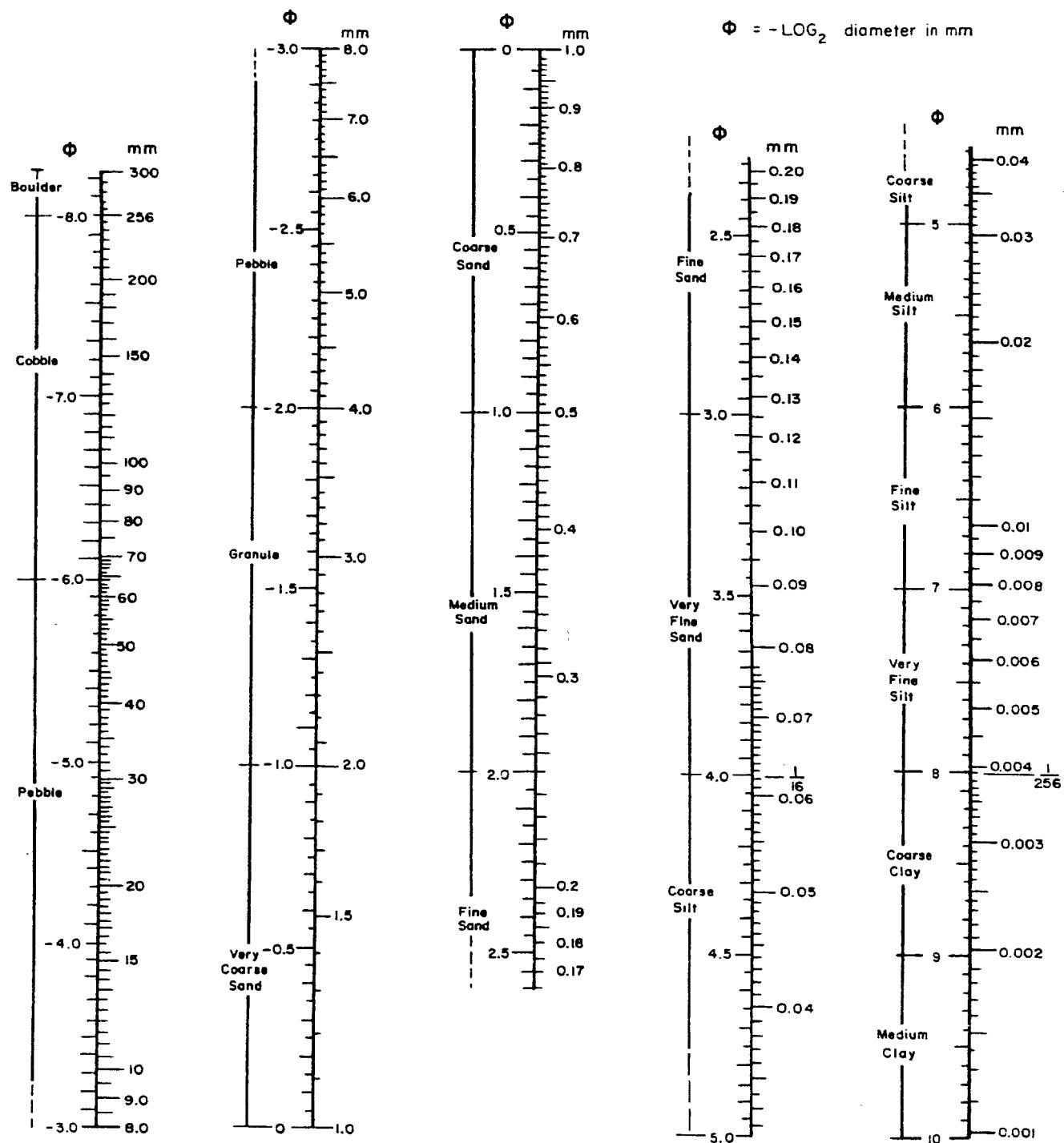
### LITERATURE CITED

Folk, R. L. 1974. Petrology of sedimentary rocks. Hemphill Publishing Co., Austin, TX. 182 p.

Inman, D. L. 1952. Measures for describing the size distribution of sediments. J. Sed. Pet. 22:125-145.

Appendix B. (Cont.).

Phi - Millimeter Conversion Figure



Measurement sorting values for a large number of sediments has suggested the following verbal classification scale for sorting:

$\sigma_1$ under	.35 $\phi$ ,	very well sorted	1.0-2.0 $\phi$ ,	poorly sorted
	.35-.50 $\phi$ ,	well sorted	2.0-4.0 $\phi$ ,	very poorly sorted
	.50-.71 $\phi$ ,	moderately well sorted	over 4.0 $\phi$ ,	extremely poorly sorted
	.71-1.0 $\phi$	moderately sorted		

## **APPENDIX C**

**Water quality parameters at each receiving water monitoring station**

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**Appendix C-1. Water quality parameters at each receiving water monitoring station during flood and ebb tides. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

	Depth (m)	Temp. (°C)		Oxygen (mg/l)		pH		Salinity (ppt)	
		FLOOD	EBB	FLOOD	EBB	FLOOD	EBB	FLOOD	EBB
RW1	0	19.88	18.88	8.05	7.63	8.12	8.04	33.16	33.28
	1	19.61	18.65	8.19	7.63	8.12	8.03	33.20	33.27
	2	19.23	18.53	8.43	7.52	8.10	8.02	33.23	33.24
	3	18.09	18.31	8.61	7.52	8.10	8.02	33.23	33.21
	4	17.33	16.36	8.51	7.83	8.10	8.03	33.20	33.24
	5	15.03	14.86	8.84	7.83	8.12	8.10	33.27	33.32
RW2	6	14.87	14.87	8.45	8.09	8.12	8.10	33.38	33.31
	0	19.55	18.99	7.84	6.94	8.08	7.98	33.22	33.27
	1	19.51	18.87	7.81	6.97	8.08	7.98	33.21	33.28
	2	19.28	18.64	7.90	6.90	8.07	7.96	33.23	33.31
	3	18.90	18.45	7.92	6.75	8.07	7.96	33.23	33.30
	4	18.48	18.08	7.92	6.76	8.06	7.98	33.21	33.29
	5	17.45	17.50	8.03	6.93	8.06	8.01	33.10	33.26
	6	15.34	17.08	8.25	7.09	8.10	7.99	33.26	33.24
	7	15.00	14.71	7.99	7.37	8.15	8.04	33.26	33.25
	8	15.23	13.97	8.52	7.63	8.15	8.02	33.36	33.34
	9	15.47	13.85	8.46	7.13	8.14	8.00	33.41	33.33
RW3	10		13.84		6.90		7.98		33.36
	0	19.05	18.69	7.61	7.36	8.08	8.02	33.21	33.27
	1	19.01	18.66	7.66	7.38	8.08	8.02	33.22	33.27
	2	18.76	18.59	7.79	7.42	8.10	8.02	33.22	33.27
	3	18.64	18.45	7.93	7.43	8.09	8.02	33.22	33.27
	4	18.15	18.14	8.07	7.44	8.07	8.01	33.18	33.26
	5	16.57	17.56	8.29	7.42	8.08	8.01	33.15	33.26
	6	15.40	16.60	8.05	7.43	8.17	8.00	33.24	33.19
	7	14.74	14.87	8.50	7.54	8.15	8.08	33.27	33.31
	8	14.47	14.35	8.84	7.74	8.10	8.08	33.27	33.30
	9	13.97	13.88	8.30	8.16	8.04	8.03	33.28	33.33
RW4	10	14.20	13.95	7.59	7.37	8.00	7.99	33.35	33.43
	0	18.56	18.38	7.95	7.24	8.08	8.01	33.12	33.26
	1	17.96	18.03	8.08	7.37	8.10	8.01	33.16	33.19
	2	17.10	16.78	8.31	7.62	8.11	8.03	33.19	33.28
	3	15.78	16.01	8.57	7.63	8.15	8.05	33.23	33.27
	4	15.58	15.32	8.58	7.77	8.20	8.12	33.25	33.28
	5	15.51	15.17	9.08	8.00	8.22	8.15	33.24	33.28
	6	15.43	15.08	9.38	8.61	8.22	8.16	33.24	33.27
	7	15.40	15.03	9.46	8.80	8.21	8.16	33.24	33.27
	8	15.39	15.01	9.38	8.85	8.19	8.16	33.23	33.27
	9	15.36	14.84	9.25	8.90	8.18	8.14	33.23	33.25
RW5	10	15.14	14.50	9.15	8.49	8.17	8.08	33.23	33.24
	0	17.91	17.37	7.61	7.20	8.06	8.01	33.17	33.29
	1	17.75	17.14	7.66	7.33	8.05	8.01	33.15	33.23
	2	17.15	16.67	7.75	7.39	8.06	7.99	33.18	33.23
	3	15.62	15.66	8.04	7.46	8.15	8.06	33.25	33.25
	4	15.49	15.17	8.17	7.78	8.19	8.15	33.25	33.34
RW6	5	15.44	15.19	8.78	8.66	8.20	8.15	33.24	33.28
	6	15.46	15.25	9.02	8.69	8.19	8.15	33.23	33.27
	0	19.03	18.61	6.89	6.41	8.01	7.94	32.58	32.83
	1	19.09	18.60	6.81	6.42	8.01	7.95	32.69	32.86
	2	19.42	18.56	6.76	6.42	8.04	7.96	33.02	33.03
	3	19.58	18.57	7.05	6.56	8.07	7.96	33.16	33.12
	4	19.46	18.48	7.60	6.73	8.06	7.96	33.12	33.13

**Appendix C-1. (Cont.).**

	Depth (m)	Temp. (°C)		Oxygen (mg/l)		pH		Salinity (ppt)	
		FLOOD	EBB	FLOOD	EBB	FLOOD	EBB	FLOOD	EBB
RW7	0	19.92	18.88	7.21	7.22	8.02	8.02	33.17	33.23
	1	19.38	18.59	7.30	7.32	8.02	8.02	33.21	33.24
	2	18.56	18.20	7.47	7.40	8.04	8.04	33.23	33.22
	3	18.20	17.80	7.51	7.51	8.07	8.04	33.19	33.23
	4	17.75	17.59	7.74	7.44	8.06	8.02	33.20	33.24
	5	17.31	17.17	7.91	7.36	8.04	8.00	33.20	33.26
	6	16.76	16.98	7.60	7.06	8.03	7.99	33.18	33.23
	7	15.35	15.62	7.59	7.16	8.08	8.04	33.17	33.19
	8	14.47	14.47	7.73	7.69	8.05	8.08	33.35	33.28
	9	14.52		7.82		8.03		33.25	
RW8	0	19.37	18.59	7.39	6.91	8.04	7.98	33.24	33.24
	1	19.37	18.54	7.41	6.94	8.04	7.98	33.22	33.28
	2	18.91	18.31	7.50	6.92	8.04	7.96	33.23	33.27
	3	18.55	17.81	7.54	6.76	8.06	8.01	33.24	33.24
	4	18.34	17.47	7.54	7.17	8.06	8.03	33.21	33.25
	5	16.92	17.17	7.94	7.39	8.06	8.01	33.14	33.26
	6	15.06	16.53	7.93	7.27	8.14	8.01	33.27	33.20
	7	15.45	14.77	8.20	7.46	8.17	8.09	33.51	33.27
	8	15.71	14.10	8.49	7.99	8.17	8.06	33.89	33.33
	9	14.41		7.38		8.03		33.60	
RW9	0	17.69	17.35	7.98	7.23	8.10	8.03	33.23	33.26
	1	17.62	17.12	7.98	7.26	8.11	8.04	33.22	33.22
	2	16.29	15.93	8.36	7.66	8.17	8.09	33.24	33.22
	3	15.69	15.57	8.46	7.83	8.21	8.14	33.25	33.27
	4	15.31	15.42	9.05	8.32	8.21	8.15	33.23	33.26
	5	15.10	15.22	9.41	8.70	8.20	8.16	33.25	33.24
	6	15.03	15.01	9.31	8.90	8.20	8.17	33.24	33.25
	7	14.97	14.93	9.24	8.93	8.19	8.16	33.23	33.28
	8	14.91	14.89	9.18	8.92	8.18	8.16	33.23	33.27
	9	14.86	14.88	9.13	8.90	8.19	8.16	33.23	33.27
	10	14.67	14.86	9.14	8.88	8.17	8.16	33.24	33.27
	11	14.56	14.80	9.06	8.87	8.16	8.15	33.24	33.26
	12	14.37	14.36	8.94	8.96	8.13	8.11	33.23	33.27
	13	14.14	14.04	8.88	8.84	8.09	8.04	33.25	33.28
	14	14.00	13.94	8.47	8.09	8.07	8.02	33.26	33.30
	15	13.92	13.85	8.07	7.59	8.05	8.01	33.27	33.31
	16	13.85	13.79	7.82	7.46	8.02	8.00	33.27	33.31
	17	13.84	13.75	7.56	7.35	8.02	7.99	33.27	33.31
	18	13.82	13.69	7.35	7.19	8.02	7.98	33.27	33.32
	19	13.81	13.65	7.25	7.02	8.01	7.97	33.27	33.32
	20	13.79	13.59	7.16	6.88	8.01	7.96	33.27	33.33
	21	13.77	13.52	7.11	6.78	8.00	7.95	33.27	33.35
	22	13.75	13.44	7.03	6.65	8.00	7.94	33.27	33.35
	23	13.72	13.43	6.97	6.47	8.00	7.93	33.28	33.35
	24	13.68	13.43	6.90	6.36	7.98	7.94	33.28	33.35
	25	13.65	13.39	6.88	6.29	7.98	7.92	33.29	33.35
	26	13.61	13.30	6.74	6.28	7.98	7.92	33.29	33.36
	27	13.56	13.30	6.64	6.22	7.96	7.91	33.30	33.37
	28	13.18	13.33	6.68	6.12	7.94	7.92	33.35	33.38
	29	13.19	13.39	6.30	6.07	7.89	7.92	33.39	33.35
RW10	0	18.12	17.43	8.44	8.43	8.14	8.13	33.20	33.15
	1	18.10	16.28	8.49	8.68	8.14	8.14	33.21	33.20
	2	16.98	15.34	8.77	8.82	8.16	8.14	33.21	33.27
	3	15.97	15.24	8.91	8.76	8.25	8.15	33.27	33.27
	4	15.59	15.23	9.29	8.83	8.27	8.16	33.24	33.26
	5	15.32	14.82	10.21	9.05	8.22	8.15	33.24	33.26
	6	15.24	14.55	9.90	9.08	8.18	8.13	33.24	33.28
	7	15.14	14.50	9.41	8.82	8.17	8.12	33.24	33.28
	8	15.06	14.44	9.17	8.54	8.16	8.10	33.24	33.27
	9	15.01	14.32	9.01	8.43	8.15	8.09	33.24	33.28
	10	15.01	14.26	8.80	8.31	8.14	8.07	33.25	33.31

**Appendix C-1. (Cont.).**

	Depth (m)	Temp. (°C)		Oxygen (mg/l)		pH		Salinity (ppt)	
		FLOOD	EBB	FLOOD	EBB	FLOOD	EBB	FLOOD	EBB
RW11	0	17.15	16.55	8.70	8.24	8.16	8.11	33.15	33.22
	1	16.86	16.44	8.61	8.23	8.17	8.11	33.20	33.25
	2	15.95	16.18	8.81	8.31	8.24	8.13	33.22	33.25
	3	15.65	15.87	9.00	8.38	8.23	8.10	33.22	33.24
	4	15.46	15.66	9.76	8.26	8.20	8.07	33.23	33.24
	5	15.33	15.49	9.37	7.99	8.18	8.07	33.23	33.25
	6	15.29	15.37	9.08	7.94	8.17	8.08	33.23	33.26
	7	15.09	15.26	9.08	8.04	8.17	8.10	33.23	33.25
	8	15.11	14.86	8.96	8.23	8.16	8.12	33.23	33.25
	9		14.35		8.33		8.06		33.33
RW12	0	17.06	16.74	8.93	8.01	8.19	8.11	33.25	33.22
	1	16.87	16.57	9.07	8.02	8.19	8.11	33.21	33.22
	2	16.44	16.40	9.36	8.09	8.23	8.12	33.16	33.21
	3	15.53	16.05	9.69	8.12	8.24	8.13	33.24	33.22
	4	15.30	15.83	9.92	8.37	8.21	8.13	33.24	33.25
	5	15.17	15.77	9.74	8.34	8.20	8.13	33.24	33.25
	6	15.09	15.77	9.47	8.35	8.18	8.14	33.23	33.24
	7	15.04	15.53	9.35	8.47	8.18	8.16	33.23	33.23
	8	15.00	15.40	9.21	8.61	8.17	8.18	33.23	33.25
	9	14.95	15.38	9.06	8.97	8.16	8.17	33.23	33.25
	10	14.84	15.35	8.99	9.05	8.15	8.18	33.24	33.25
	11	14.75	14.98	8.94	9.18	8.14	8.17	33.23	33.27
	12	14.74	14.76	8.76	9.07	8.14	8.12	33.25	33.30
RW13	0	17.27	17.83	9.70	7.97	8.26	8.12	33.23	33.10
	1	17.10	17.34	9.76	8.17	8.28	8.16	33.22	33.17
	2	16.33	16.52	10.59	8.29	8.34	8.25	33.27	33.18
	3	15.73	15.98	11.50	8.72	8.26	8.26	33.28	33.22
	4	15.45	15.95	10.48	9.67	8.20	8.20	33.27	33.22
	5	15.24	15.78	9.74	9.21	8.19	8.16	33.25	33.21
	6	15.10	15.54	9.43	8.89	8.20	8.19	33.25	33.24
	7	14.92	15.29	9.45	8.88	8.18	8.19	33.25	33.22
	8	14.74	14.71	9.27	9.17	8.15	8.15	33.24	33.22
	9	14.67	14.47	8.98	8.89	8.12	8.13	33.21	33.23
	10	14.42	14.24	8.82	8.60	8.09	8.08	33.27	33.26
	11	14.14	14.02	8.29	8.27	8.04	8.05	33.27	33.27
	12	14.05	14.00	7.77	7.73	8.03	8.02	33.29	33.28
RW14	0	17.52	16.08	8.84	7.99	8.17	8.13	33.20	33.18
	1	17.42	15.99	8.83	8.00	8.18	8.14	33.15	33.20
	2	16.71	15.83	9.05	8.03	8.24	8.15	33.24	33.21
	3	16.18	15.72	9.84	8.20	8.24	8.15	33.32	33.20
	4	15.40	15.42	10.07	8.43	8.19	8.19	33.32	33.22
	5	15.24	15.06	9.42	8.58	8.19	8.17	33.23	33.23
	6	15.08	14.66	9.23	9.01	8.18	8.15	33.24	33.23
	7	15.01	14.46	9.08	8.86	8.16	8.11	33.24	33.25
	8	14.98	14.37	8.83	8.58	8.15	8.09	33.24	33.25
RW15	9	14.95	14.39	8.65	8.12	8.12	8.08	33.24	33.25
	0	16.68	16.22	7.64	7.87	8.13	8.13	33.18	33.23
	1	16.65	16.21	7.58	7.84	8.13	8.12	33.19	33.23
	2	16.59	16.22	7.68	7.87	8.13	8.13	33.19	33.22
	3	16.57	15.99	7.80	7.92	8.13	8.12	33.20	33.21
	4	16.39	15.40	7.86	8.03	8.15	8.14	33.20	33.25
	5	16.08	15.48	8.17	8.15	8.17	8.14	33.25	33.25
	6	16.03	15.56	8.42	8.21	8.18	8.13	33.21	33.20

**Appendix C-1. (Cont.).**

Depth (m)	Temp. (°C)		Oxygen (mg/l)		pH		Salinity (ppt)		
	FLOOD	EBB	FLOOD	EBB	FLOOD	EBB	FLOOD	EBB	
RW16	0	17.29	17.04	9.58	8.08	8.23	8.14	33.21	33.20
	1	17.28	16.97	9.61	8.10	8.23	8.15	33.21	33.22
	2	17.24	16.44	9.61	8.24	8.21	8.14	33.21	33.20
	3	17.08	15.83	9.57	8.28	8.19	8.11	33.18	33.22
	4	16.13	15.44	9.65	7.99	8.19	8.12	33.24	33.21
	5	15.90	14.92	9.49	7.99	8.19	8.15	33.23	33.23
	6	15.87	14.63	9.23	8.23	8.18	8.13	33.19	33.24
	7	15.62	14.51	9.17	8.52	8.17	8.11	33.23	33.25
	8	15.54	14.37	9.05	8.27	8.17	8.09	33.22	33.25
	9	15.45	14.40	8.88	8.08	8.16	8.07	33.21	33.31

**Appendix C-2. Water quality parameters at each receiving water monitoring station during flood and ebb tides. AES Redondo Beach L.L.C. generating station NPDES, summer 2001.**

	Depth (m)	Temp. (°C)		Oxygen (mg/l)		pH		Salinity (ppt)	
		FLOOD	EBB	FLOOD	EBB	FLOOD	EBB	FLOOD	EBB
RW1	0	23.90	23.17	6.68	6.45	7.91	7.90	33.53	33.53
	1	23.41	22.27	6.77	6.75	7.92	7.90	33.48	33.55
	2	22.69	22.18	6.70	6.64	7.92	7.91	33.52	33.47
	3	21.36	21.18	6.83	6.76	7.95	7.92	33.44	33.62
	4	19.79	18.65	7.03	7.09	7.98	7.94	33.54	33.85
	5	18.33	17.58	7.27	6.82	7.98	7.93	33.60	33.76
	6	17.76	15.60	7.18	7.05	7.97	7.94	33.53	33.60
	7	17.24	15.25	7.15	6.99	7.96	7.94	33.51	33.61
	8		14.93		7.09		7.93		33.51
RW2	0	24.36	22.47	6.54	6.51	7.92	7.90	33.48	33.48
	1	24.22	22.43	6.60	6.57	7.91	7.89	33.48	33.52
	2	23.90	22.35	6.65	6.57	7.92	7.88	33.48	33.53
	3	23.31	22.27	6.68	6.53	7.91	7.88	33.49	33.50
	4	22.18	21.51	6.80	6.46	7.92	7.89	33.55	33.54
	5	20.48	19.17	6.88	6.26	7.94	7.93	33.71	33.56
	6	19.37	16.90	6.76	7.00	8.00	7.95	33.54	33.57
	7	18.29	15.92	7.35	7.21	8.00	7.95	33.52	33.53
	8	16.20	15.36	7.53	7.16	7.97	7.94	33.50	33.51
	9	15.32	15.38	7.26	7.16	7.96	7.94	33.49	33.50
	10	14.84		7.32		7.94			33.53
RW3	0	23.95	21.86	6.37	6.54	7.92	7.88	33.50	33.53
	1	23.96	21.85	6.45	6.58	7.92	7.88	33.50	33.52
	2	23.74	21.85	6.55	6.54	7.91	7.88	33.50	33.52
	3	23.54	21.83	6.53	6.55	7.91	7.88	33.50	33.51
	4	22.15	21.39	6.74	6.58	7.92	7.89	33.51	33.52
	5	20.76	19.34	6.61	6.69	7.94	7.94	33.50	33.55
	6	19.77	16.33	6.84	7.12	8.00	7.94	33.45	33.57
	7	18.19	15.23	7.43	7.05	7.99	7.94	33.50	33.50
	8	16.39	14.84	7.48	7.29	7.96	7.92	33.50	33.51
	9	15.39	14.51	7.24	7.13	7.94	7.91	33.46	33.53
	10	14.85	14.35	7.21	7.00	7.93	7.90	33.52	33.50
	11	14.79		7.13		7.92			33.55
RW4	0	22.07	20.38	6.63	6.38	7.92	7.88	33.43	33.60
	1	21.36	20.17	6.81	6.45	7.92	7.89	33.46	33.52
	2	20.96	19.75	6.77	6.48	7.94	7.89	33.47	33.54
	3	20.76	19.18	6.81	6.55	7.95	7.90	33.48	33.53
	4	20.33	18.79	6.94	6.58	7.99	7.90	33.51	33.58
	5	19.87	18.30	7.12	6.65	8.00	7.91	33.42	33.57
	6	19.39	16.18	7.31	7.11	8.00	7.93	33.48	33.58
	7	19.03	15.97	7.34	6.93	7.99	7.94	33.52	33.58
	8	18.73	15.92	7.30	7.20	7.99	7.94	33.50	33.57
	9	17.47	15.90	7.46	7.19	7.96	7.94	33.50	33.58
	10	16.05	15.75	7.42	7.19	7.94	7.94	33.50	33.53
	11	15.41	15.57	7.28	7.15	7.94	7.93	33.53	33.51
RW5	0	21.87	20.11	6.52	6.44	7.90	7.89	33.45	33.51
	1	21.60	20.11	6.61	6.49	7.90	7.89	33.45	33.48
	2	21.06	20.04	6.69	6.50	7.95	7.89	33.45	33.55
	3	20.35	19.78	6.88	6.57	7.98	7.89	33.45	33.55
	4	19.97	18.89	7.15	6.78	7.99	7.89	33.39	33.58
	5	19.54	16.47	7.25	7.14	8.00	7.91	33.49	33.57
	6	19.25	16.70	7.30	6.75	8.00	7.91	33.80	33.58
RW6	7	19.26		7.25		8.01			33.61
	0	24.78	22.74	6.53	5.90	7.91	7.90	33.07	33.51
	1	24.79	22.68	6.56	5.96	7.91	7.90	33.22	33.51
	2	24.74	22.57	6.57	6.01	7.91	7.88	33.36	33.51
	3	24.44	22.42	6.63	6.31	7.91	7.88	33.36	33.50
	4	23.62	21.99	6.72	6.45	7.91	7.88	33.33	33.36
	5	23.04	20.90	6.55	6.46	7.90	7.88	33.33	33.41
	6		19.34		6.49		7.90		34.05

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**Appendix C-2. (Cont.).**

	Depth (m)	Temp. (°C)		Oxygen (mg/l)		pH		Salinity (ppt)	
		FLOOD	EBB	FLOOD	EBB	FLOOD	EBB	FLOOD	EBB
RW7	0	24.02	22.48	6.43	5.90	7.90	7.88	33.56	33.51
	1	23.70	22.21	6.51	5.93	7.90	7.88	33.54	33.50
	2	23.22	21.66	6.52	5.99	7.90	7.89	33.55	33.52
	3	22.35	21.29	6.66	5.96	7.90	7.88	33.53	33.52
	4	21.94	20.47	6.61	6.14	7.93	7.89	33.51	33.57
	5	21.57	18.86	6.47	6.45	7.92	7.94	33.29	33.51
	6	19.63	16.63	6.62	6.89	7.95	7.95	33.48	33.50
	7	18.84	15.64	6.74	7.20	7.96	7.93	33.52	33.50
	8	16.84	15.13	7.15	7.05	7.96	7.93	33.48	33.53
	9	15.84	14.79	7.13	7.05	7.96	7.92	33.47	33.50
	10		14.57		7.03		7.90		33.50
RW8	0	24.69	22.52	6.48	5.95	7.91	7.90	33.54	33.52
	1	24.45	22.49	6.56	5.97	7.91	7.90	33.53	33.51
	2	23.80	22.25	6.63	5.97	7.91	7.90	33.53	33.48
	3	23.05	21.79	6.69	6.24	7.91	7.90	33.54	33.49
	4	22.67	21.11	6.61	6.40	7.90	7.91	33.59	33.48
	5	20.63	17.90	6.95	6.75	7.93	7.95	33.67	33.51
	6	19.66	16.26	6.70	6.81	7.97	7.94	33.61	33.56
	7	18.78	15.68	7.04	7.19	7.98	7.94	33.54	33.55
	8	15.84	15.51	7.70	7.24	7.97	7.94	33.52	33.50
	9	15.94		7.10		7.96			33.67
RW9	0	21.29	19.30	6.88	6.73	7.94	7.91	33.50	33.55
	1	21.31	19.22	6.88	6.77	7.94	7.93	33.54	33.54
	2	20.51	19.10	7.02	6.83	7.95	7.96	33.57	33.64
	3	19.82	18.96	7.08	7.02	7.97	7.97	33.56	33.59
	4	19.58	18.73	7.18	7.18	7.98	7.97	33.55	33.59
	5	19.46	18.33	7.26	7.26	7.99	7.97	33.56	33.58
	6	19.16	17.66	7.34	7.34	7.99	7.96	33.55	33.57
	7	18.86	17.24	7.35	7.24	7.99	7.94	33.53	33.58
	8	18.53	16.86	7.35	7.14	7.98	7.93	33.52	33.58
	9	18.28	16.56	7.32	7.15	7.97	7.94	33.52	33.56
	10	17.88	16.18	7.32	7.21	7.96	7.94	33.57	33.54
	11	17.27	15.86	7.33	7.32	7.96	7.94	33.51	33.53
	12	17.12	15.43	7.21	7.39	7.96	7.95	33.51	33.55
	13	16.90	15.37	7.29	7.42	7.96	7.94	33.48	33.52
	14	16.83	15.25	7.31	7.40	7.95	7.93	33.48	33.52
	15	16.70	15.11	7.34	7.37	7.95	7.92	33.50	33.52
	16	16.59	14.95	7.31	7.29	7.96	7.92	33.44	33.51
	17	15.60	14.90	7.51	7.24	7.93	7.91	33.49	33.52
	18	15.34	14.82	7.32	7.19	7.92	7.90	33.47	33.51
	19	15.31	14.77	7.19	7.18	7.92	7.90	33.45	33.48
	20	15.30	14.66	7.23	7.17	7.92	7.90	33.46	33.48
	21	15.29	14.44	7.25	7.16	7.92	7.90	33.45	33.47
	22	15.29	14.26	7.23	7.16	7.92	7.89	33.44	33.47
	23	15.27	14.20	7.23	7.00	7.92	7.89	33.44	33.47
	24	15.28	14.16	7.23	6.92	7.92	7.88	33.44	33.47
	25	15.27	14.18	7.25	6.90	7.92	7.88	33.44	33.47
	26	15.22	14.12	7.25	6.89	7.92	7.88	33.43	33.47
	27	15.13	14.11	7.28	6.88	7.91	7.87	33.44	33.47
	28	15.00	14.05	7.23	6.86	7.90	7.87	33.44	33.48
	29	14.86	13.96	7.19	6.84	7.89	7.87	33.43	33.47
	30		13.92		6.78		7.86		33.43
RW10	0	20.94	20.33	7.13	6.82	8.00	7.99	33.56	33.58
	1	20.93	20.19	7.16	6.86	8.00	7.99	33.56	33.58
	2	20.79	19.38	7.21	7.02	8.00	7.99	33.57	33.58
	3	20.54	18.07	7.23	7.29	8.00	7.97	33.50	33.56
	4	20.32	17.10	7.23	7.36	8.00	7.94	33.48	33.57
	5	20.11	17.06	7.21	7.11	7.99	7.95	33.51	33.52
	6	19.40	16.40	7.27	7.31	7.98	7.94	33.52	33.43
	7	18.63	16.23	7.25	7.30	7.97	7.94	33.52	33.51
	8	18.30	16.22	7.17	7.33	7.97	7.95	33.51	33.52
	9	17.64	16.08	7.29	7.39	7.97	7.96	33.53	33.59
	10		15.96		7.45		7.96		33.51
	11		15.84		7.52		7.96		33.52

**Appendix C-2. (Cont.).**

	Depth (m)	Temp. (°C)		Oxygen (mg/l)		pH		Salinity (ppt)	
		FLOOD	EBB	FLOOD	EBB	FLOOD	EBB	FLOOD	EBB
RW11	0	20.94	18.49	7.18	6.87	8.02	7.94	33.48	33.58
	1	20.92	18.08	7.20	6.95	8.01	7.93	33.49	33.58
	2	20.89	17.59	7.20	6.96	8.00	7.92	33.49	33.58
	3	20.81	16.74	7.22	7.11	8.00	7.92	33.51	33.57
	4	20.59	16.11	7.22	7.15	7.99	7.92	33.51	33.55
	5	20.29	15.78	7.18	7.25	7.98	7.92	33.50	33.55
	6	19.81	15.58	7.12	7.25	7.97	7.92	33.58	33.54
	7	19.40	15.39	6.99	7.27	7.97	7.91	33.50	33.53
	8	18.68	15.37	7.00	7.19	7.98	7.90	33.48	33.51
	9	18.14	15.21	7.23	7.20	7.97	7.90	33.50	33.42
	10		15.24		7.14		7.90		33.47
RW12	0	20.99	19.88	7.25	6.91	8.02	7.99	33.50	33.60
	1	20.96	19.83	7.26	6.94	8.02	7.98	33.54	33.60
	2	20.89	17.74	7.28	7.39	8.03	7.97	33.51	33.59
	3	20.83	17.20	7.27	7.20	8.02	7.95	33.55	33.59
	4	20.66	17.00	7.27	7.28	8.01	7.96	33.53	33.58
	5	20.11	16.89	7.26	7.30	7.99	7.95	33.51	33.56
	6	19.45	16.20	7.17	7.43	8.00	7.94	33.52	33.59
	7	19.27	15.98	7.43	7.35	8.01	7.95	33.52	33.58
	8	18.68	15.86	7.55	7.36	8.01	7.94	33.51	33.57
	9	17.86	15.68	7.62	7.46	7.99	7.94	33.55	33.61
	10	17.13	15.34	7.60	7.55	7.98	7.94	33.57	33.53
	11	16.77	15.01	7.52	7.56	7.97	7.94	33.49	33.54
	12	16.73	15.00	7.40	7.51	7.96	7.93	33.49	33.52
	13		14.81		7.51		7.93		33.53
RW13	0	20.92	20.50	7.19	6.75	8.01	7.99	33.57	33.58
	1	20.90	20.49	7.19	6.78	8.01	7.99	33.57	33.59
	2	20.83	20.37	7.21	6.83	8.01	7.98	33.55	33.59
	3	20.60	19.96	7.25	6.91	8.01	8.00	33.58	33.62
	4	20.15	19.23	7.32	7.16	8.00	7.99	33.57	33.63
	5	19.81	18.44	7.32	7.31	8.01	7.98	33.62	33.57
	6	19.10	17.80	7.45	7.31	7.99	7.97	33.56	33.58
	7	18.97	17.62	7.30	7.26	7.97	7.97	33.56	33.54
	8	18.75	17.52	7.18	7.26	7.98	7.97	33.55	33.56
	9	18.00	16.99	7.28	7.40	7.99	7.97	33.52	33.59
	10	17.71	16.05	7.40	7.56	7.99	7.97	33.52	33.56
	11	17.59	15.74	7.43	7.59	7.97	7.98	33.54	33.53
	12	15.94	15.44	7.75	7.78	7.97	7.97	33.57	33.50
	13	16.04	15.21	7.55	7.81	7.97	7.96	33.58	33.55
	14		15.16		7.72		7.96		33.54
RW14	0	20.73	20.41	7.18	6.75	8.00	7.97	33.57	33.58
	1	20.68	20.17	7.21	6.82	8.01	7.97	33.57	33.57
	2	20.40	19.57	7.27	6.93	8.00	7.98	33.64	33.62
	3	20.27	18.64	7.26	7.29	8.00	7.98	33.56	33.58
	4	20.17	17.97	7.22	7.30	8.00	7.97	33.59	33.56
	5	19.84	17.55	7.24	7.34	8.00	7.96	33.58	33.53
	6	19.44	17.33	7.24	7.34	7.99	7.96	33.53	33.52
	7	19.27	16.84	7.19	7.40	7.99	7.96	33.59	33.53
	8	19.06	16.10	7.17	7.51	7.97	7.95	33.52	33.52
	9	18.08	15.84	7.35	7.47	7.97	7.94	33.58	33.50
	10	16.50	15.76	7.54	7.52	7.96	7.94	33.51	33.62
	11		15.77		7.51		7.94		33.55
RW15	0	20.89	20.04	7.16	6.88	8.00	7.98	33.53	33.58
	1	20.89	19.86	7.16	6.92	8.01	7.98	33.56	33.58
	2	20.85	19.46	7.14	6.97	8.00	7.98	33.57	33.57
	3	20.76	19.21	7.17	7.03	8.00	7.98	33.57	33.58
	4	20.46	19.07	7.16	7.07	7.99	7.97	33.57	33.53
	5		18.14		7.22		7.96		33.49

**Appendix C-2. (Cont.).**

	Depth (m)	Temp. (°C)		Oxygen (mg/l)		pH		Salinity (ppt)	
		FLOOD	EBB	FLOOD	EBB	FLOOD	EBB	FLOOD	EBB
RW16	0	20.52	20.46	7.18	6.88	8.02	7.99	33.59	33.58
	1	20.50	20.35	7.21	6.93	8.01	7.98	33.59	33.59
	2	20.42	19.99	7.25	6.99	8.01	7.99	33.60	33.58
	3	19.90	19.69	7.34	6.93	8.00	7.98	33.64	33.58
	4	19.11	19.46	7.37	7.03	8.00	7.99	33.59	33.63
	5	18.61	19.20	7.39	7.19	7.99	7.99	33.56	33.59
	6	18.54	18.09	7.32	7.45	7.97	7.97	33.56	33.61
	7	18.41	16.94	7.33	7.50	7.97	7.95	33.57	33.56
	8	17.60	15.84	7.38	7.46	7.97	7.94	33.54	33.49
	9	16.03	15.76	7.56	7.37	7.96	7.94	33.55	33.58
	10	16.05	15.98	7.48	7.52	7.96	7.94	33.50	33.61

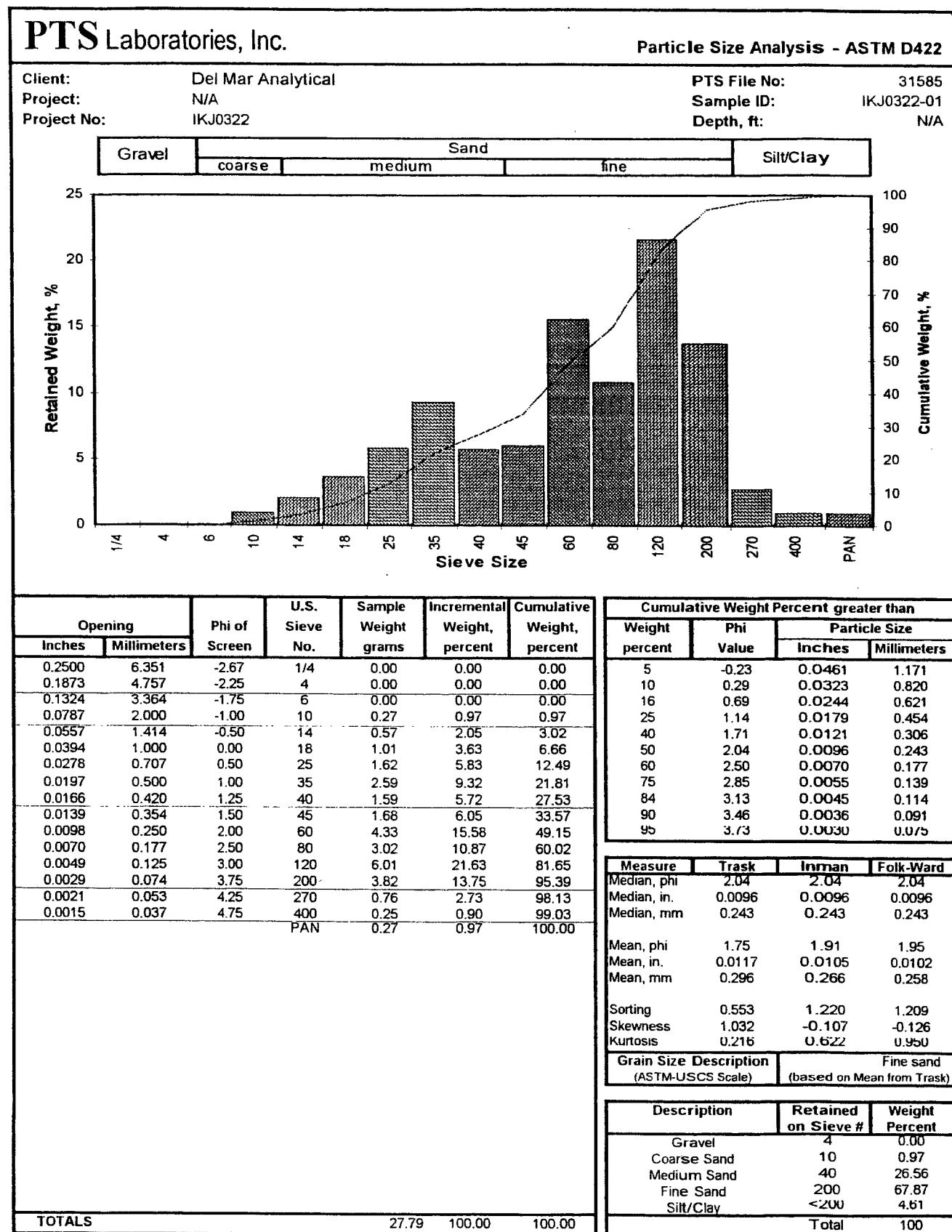
## **APPENDIX D**

**Sediment grain size distribution and statistical parameters by station**

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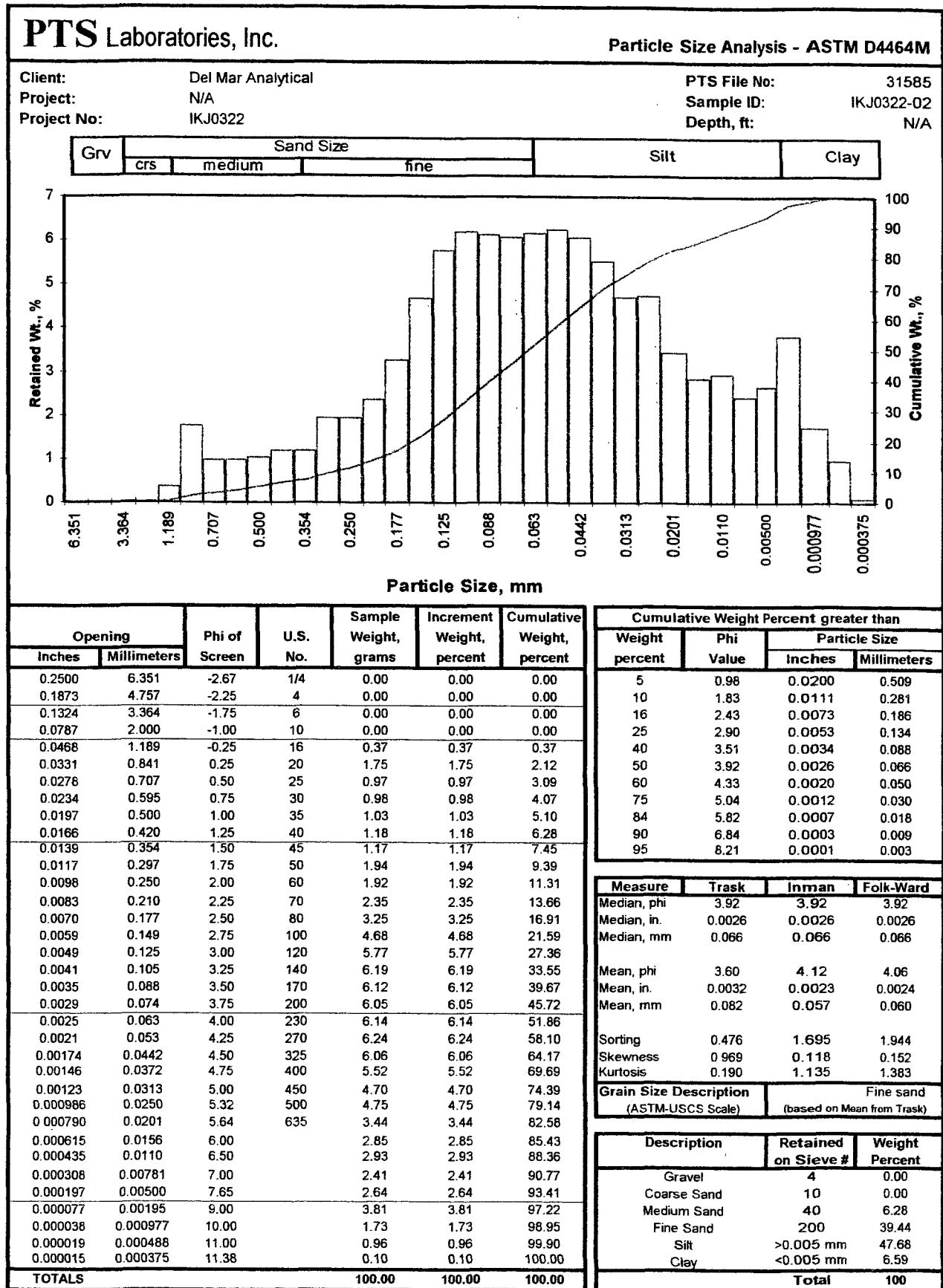
**Appendix D. Sediment grain size distribution and statistical parameters by station. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

**Station B1**



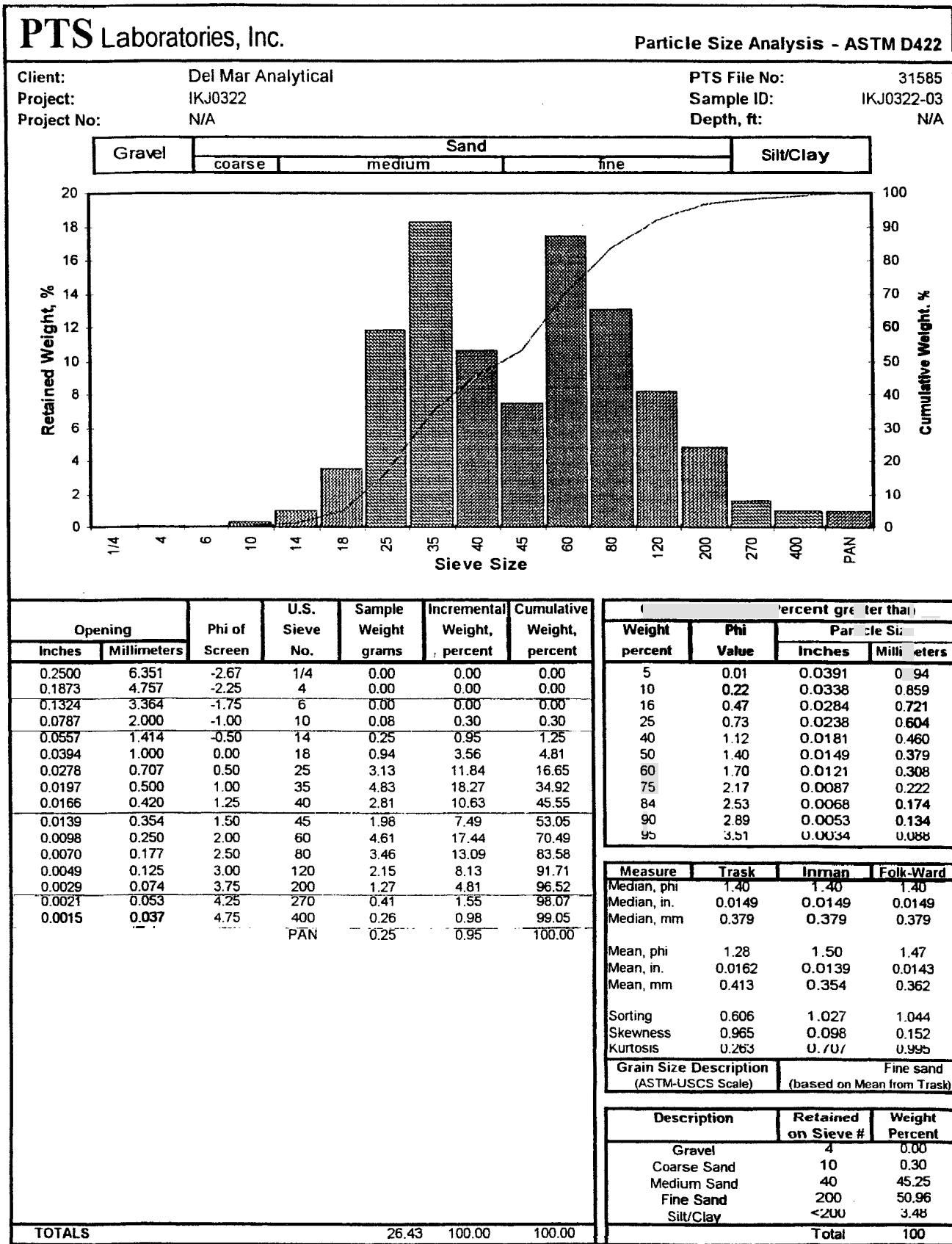
Appendix D. (Cont.).

Station B2



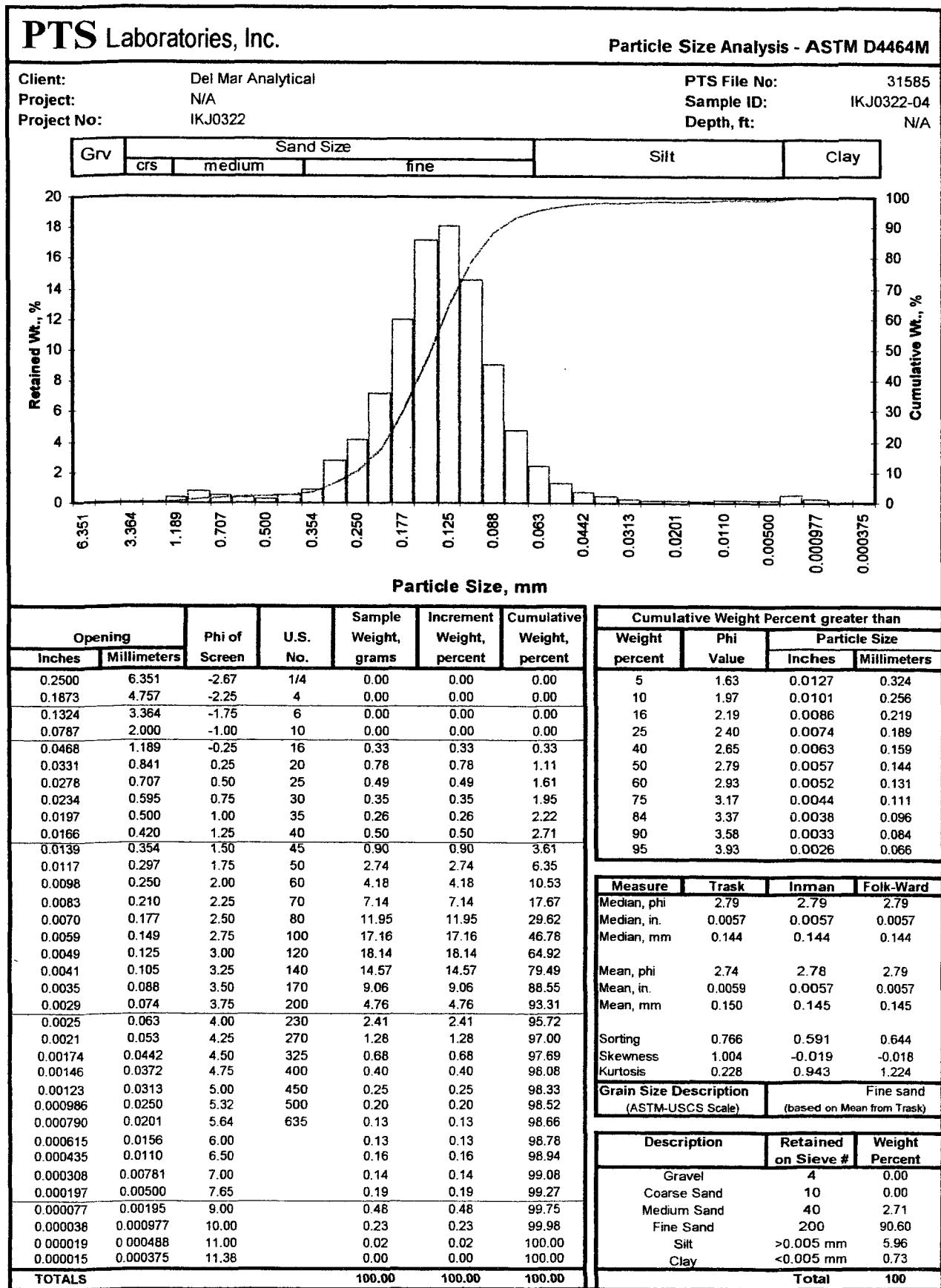
Appendix D. (Cont.).

Station B3



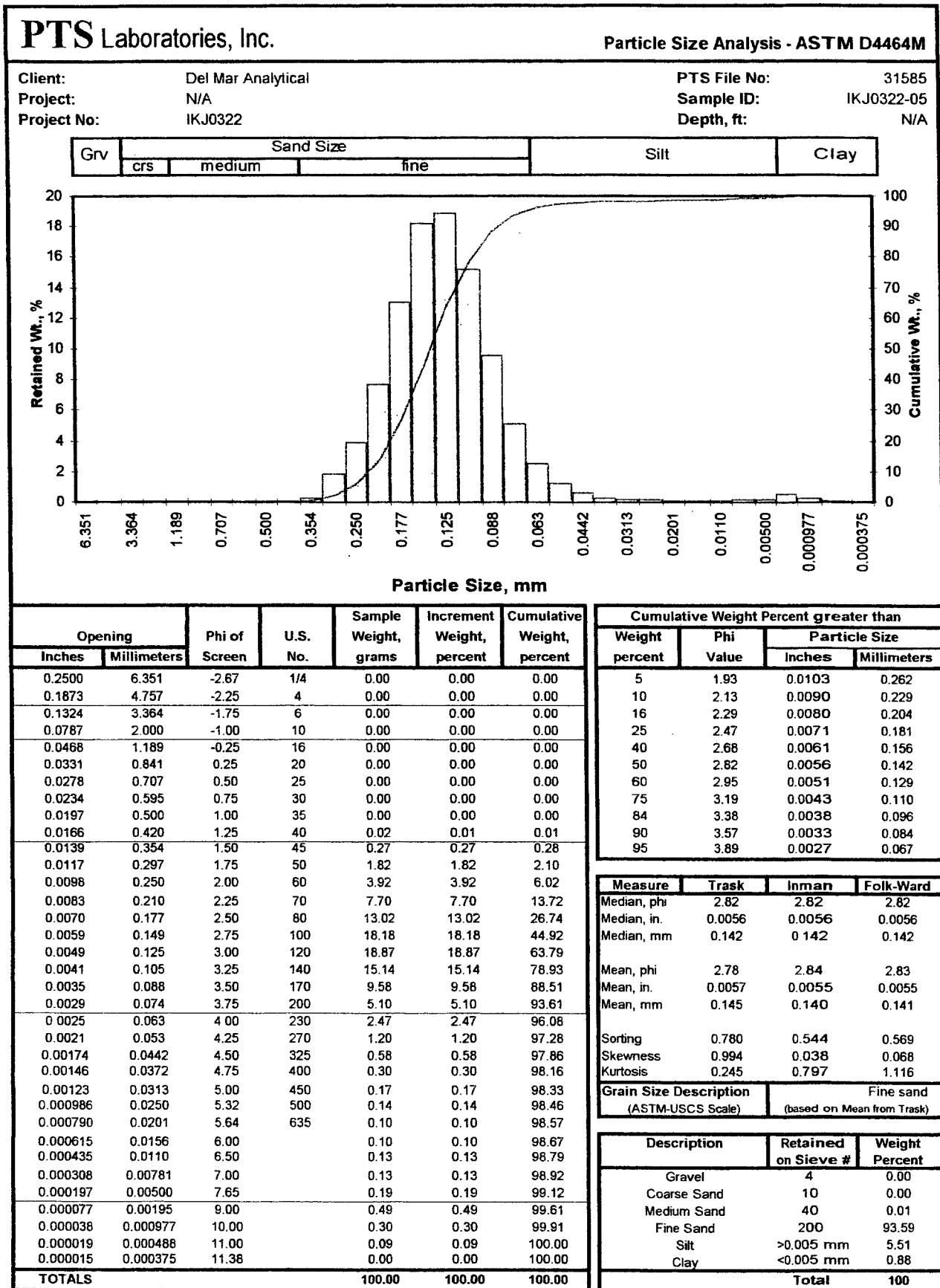
Appendix D. (Cont.).

Station B4



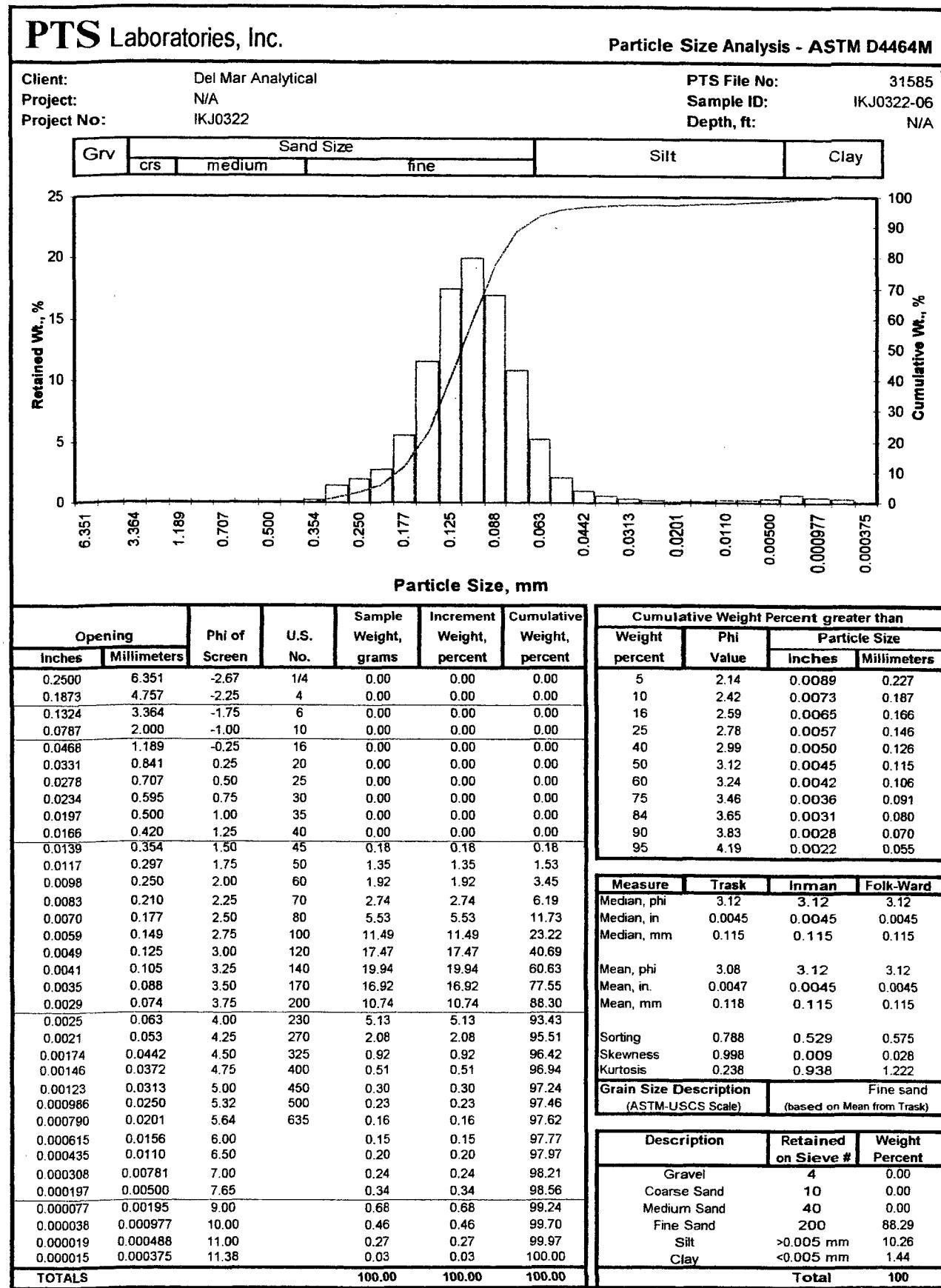
Appendix D. (Cont.).

Station B5



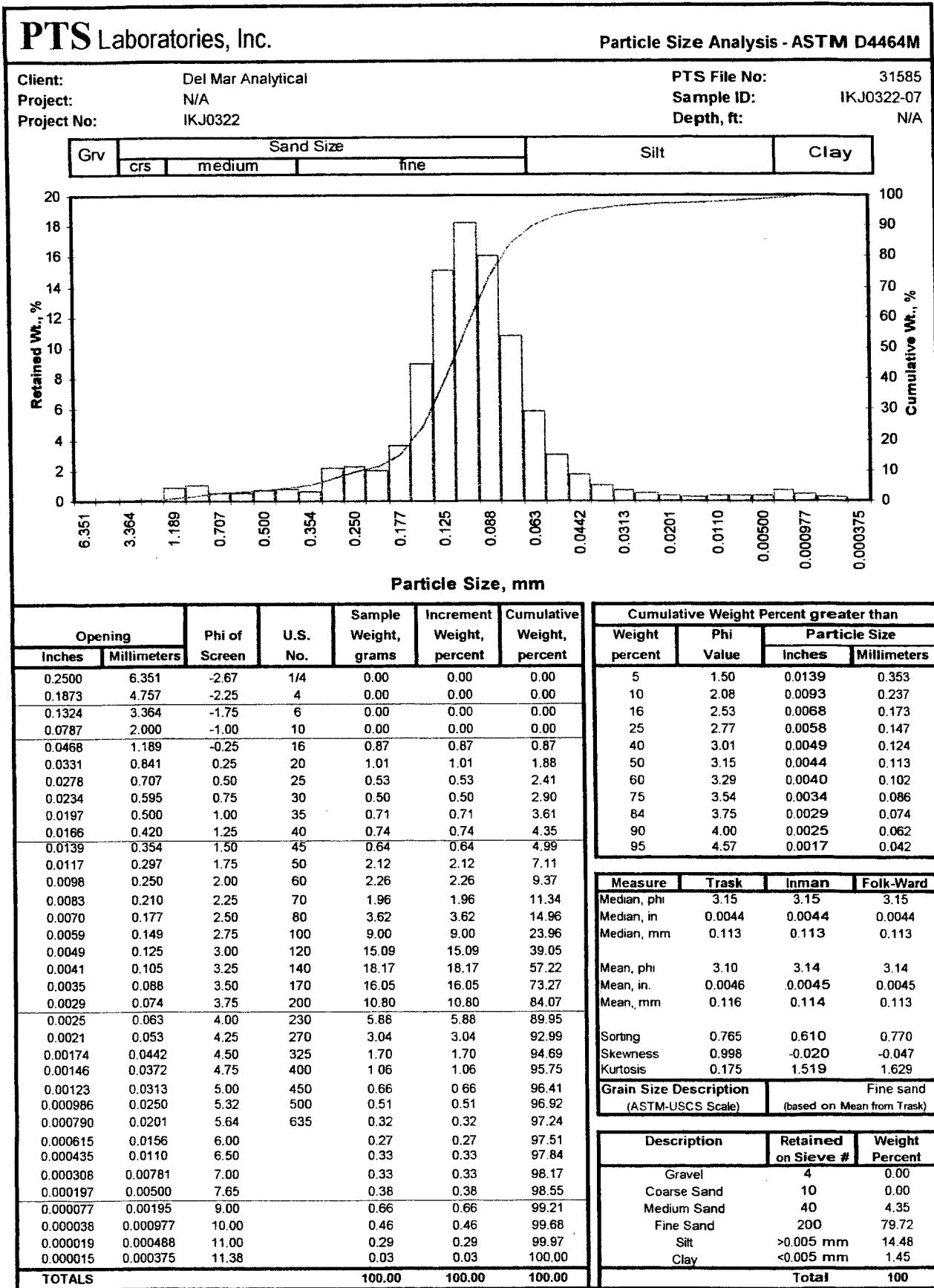
Appendix D. (Cont.).

Station B6



Appendix D. (Cont.).

Station B7



**Appendix D-1. Yearly grain size values, 1978 - 2001. AES Redondo Beach L.L.C. generating stations NPDES, 2001.**

Year	Season	Station	Mean grain size								
			Gravel (%)	Sand (%)	Silt (%)	Clay (%)	phi	µm	Sorting	Skewness	Kurtosis
2001	Summer	B1	0.97	95.79	3.24	0.00	1.95	258	1.21	-0.13	0.95
		B2	0.00	51.86	41.55	6.59	4.06	60	1.94	0.15	1.38
		B3	0.30	97.00	2.70	0.00	1.47	362	1.04	0.15	1.00
		B4	0.00	95.72	3.55	0.73	2.79	145	0.64	-0.02	1.22
		B5	0.00	96.08	3.04	0.88	2.83	140	0.57	0.07	1.12
		B6	0.00	93.43	5.13	1.44	3.12	120	0.58	0.03	1.22
		B7	0.00	89.95	8.60	1.45	3.14	113	0.77	-0.05	1.63
		B8	-	-	-	-	-	-	-	-	-
2000	Summer	B1	0.00	87.09	9.19	3.72	1.91	265	1.86	0.20	1.39
		B2	0.00	50.87	43.27	5.86	4.14	57	1.67	0.27	1.17
		B3	0.00	92.82	5.60	1.58	1.33	397	1.45	0.26	1.24
		B4	0.00	94.48	4.47	1.05	2.74	149	0.72	0.04	1.11
		B5	0.00	94.55	3.88	1.57	2.59	166	0.69	0.19	1.20
		B6	0.00	90.99	7.59	1.42	3.21	108	0.58	0.09	1.22
		B7	0.00	97.62	1.87	0.51	0.86	551	0.70	0.28	1.39
		B8	-	-	-	-	-	-	-	-	-
1999	Summer	B1	0.00	88.58	8.49	2.93	1.82	283	1.79	0.12	1.31
		B2	0.00	76.80	19.31	3.89	2.69	155	1.98	0.31	1.83
		B3	0.00	96.80	2.57	0.63	1.20	437	1.10	0.13	1.10
		B4	0.00	96.87	2.41	0.72	2.20	218	0.96	-0.12	1.32
		B5	0.00	96.86	2.57	0.57	2.48	179	0.64	0.13	1.05
		B6	0.00	93.02	5.73	1.25	2.97	127	0.72	-0.05	1.22
		B7	0.00	99.26	0.60	0.14	0.30	811	0.61	0.08	1.30
		B8	-	-	-	-	-	-	-	-	-
1998	Summer	B1	0.00	92.35	5.46	2.19	2.46	182	48.19	-0.21	1.09
		B2	0.02	71.88	21.54	6.56	3.59	83	38.01	0.29	1.82
		B3	0.00	96.30	2.21	1.48	3.01	124	64.69	-0.08	1.27
		B4	0.23	92.91	6.87	0.00	3.27	104	70.14	-0.04	1.54
		B5	-	-	-	-	-	-	-	-	-
		B6	-	-	-	-	-	-	-	-	-
		B7	-	-	-	-	-	-	-	-	-
		B8	-	-	-	-	-	-	-	-	-
1997	Summer	B1	0.01	94.51	3.59	1.89	1.89	260	46.42	0.11	1.19
		B2	0.00	78.89	15.96	5.32	3.22	107	44.54	0.43	1.71
		B3	2.51	95.64	1.46	0.40	1.47	362	51.91	-0.15	0.94
		B4	0.00	98.45	1.05	0.49	2.81	143	74.51	0.12	1.22
		B5	0.00	92.09	7.05	0.86	3.28	103	66.40	0.02	1.13
		B6	0.01	92.98	5.92	1.09	3.35	98	70.03	-0.01	1.30
		B7	0.01	93.70	5.96	0.34	3.15	113	61.49	-0.23	1.36
		B8	-	-	-	-	-	-	-	-	-
1994	Summer	B1	0.05	88.02	11.35	0.59	2.57	168	48.69	-0.25	1.14
		B2	0.00	78.24	18.78	2.98	3.46	91	47.25	0.37	1.64
		B3	1.51	94.67	3.03	0.79	1.50	354	49.15	0.18	1.04
		B4	0.07	97.65	1.89	0.40	2.92	132	71.57	0.07	1.06
		B5	0.05	95.61	3.89	0.00	2.97	128	64.70	-0.18	1.33
		B6	0.00	94.48	5.04	0.48	2.96	129	61.06	-0.45	1.05
		B7	0.02	91.95	7.98	0.06	3.34	99	72.01	-0.12	1.50
		B8	-	-	-	-	-	-	-	-	-
1993	Summer	B1	0.00	91.69	7.73	0.58	1.97	255	49.77	0.21	1.00
		B2	0.00	73.90	23.44	2.66	3.44	92	42.30	0.22	1.58
		B3	0.82	97.72	1.15	0.32	1.32	401	54.57	0.07	1.02
		B4	0.00	97.13	2.83	0.04	2.97	128	71.53	0.05	1.04
		B5	1.54	91.92	6.38	0.15	3.08	118	67.83	-0.07	1.03
		B6	0.00	94.84	5.16	0.00	2.88	136	61.36	-0.41	0.81
		B7	0.00	92.69	6.77	0.53	3.44	92	77.70	-0.06	1.05
		B8	-	-	-	-	-	-	-	-	-
1992	Summer	B1	0.00	96.54	2.56	0.90	2.01	N.A.	55.69	0.04	0.83
		B2	0.00	85.34	12.50	2.16	2.95	N.A.	53.09	0.33	1.48
		B3	5.09	42.35	51.66	0.90	2.93	N.A.	52.97	-0.90	1.02
		B4	0.00	95.24	4.33	0.43	2.98	N.A.	68.14	0.08	1.39
		B5	0.00	98.79	1.16	0.05	2.59	N.A.	79.11	0.04	1.14
		B6	3.04	90.65	6.31	0.00	2.76	N.A.	57.04	-0.34	1.69
		B7	0.00	96.27	3.70	0.03	2.86	N.A.	63.61	-0.37	1.89
		B8	-	-	-	-	-	-	-	-	-

**Appendix D-1. (Cont.).**

Year	Season	Station	Mean grain size								
			Gravel (%)	Sand (%)	Silt (%)	Clay (%)	phi	$\mu m$	Sorting	Skewness	Kurtosis
1991	Summer	B1	0.00	98.81	1.18	0.02	1.47	N.A.	63.83	0.25	1.15
		B2	0.02	85.99	14.00	0.00	2.41	N.A.	49.17	0.14	1.03
		B3	5.97	91.98	2.05	0.00	1.73	N.A.	58.90	-0.34	2.79
		B4	0.00	94.64	5.36	0.00	2.97	N.A.	57.67	0.15	1.44
		B5	0.00	97.44	2.56	0.00	2.80	N.A.	76.85	0.19	1.27
		B6	0.03	93.80	6.17	0.00	3.11	N.A.	68.66	0.13	1.33
		B7	0.03	75.97	22.82	1.18	2.83	N.A.	41.86	0.40	0.95
		B8	-	-	-	-	-	-	-	-	-
1990	Summer	B1	0.21	96.93	1.63	1.22	1.65	N.A.	60.73	0.12	1.10
		B2	1.76	89.99	6.92	1.34	2.12	N.A.	62.27	0.44	2.31
		B3	0.08	93.82	5.14	0.96	2.44	N.A.	55.58	-0.02	1.28
		B4	0.00	94.12	5.88	0.00	2.79	N.A.	70.70	0.22	1.67
		B5	0.00	97.63	1.71	0.66	2.73	N.A.	78.77	0.09	1.36
		B6	0.00	92.84	7.08	0.07	3.01	N.A.	61.65	-0.01	1.61
		B7	0.00	98.88	0.84	0.11	0.84	N.A.	70.88	0.30	1.82
		B8	-	-	-	-	-	-	-	-	-
1988	Winter	B1	0.44	97.38	1.17	0.62	1.50	N.A.	61.36	0.15	1.06
		B2	0.00	94.00	5.93	0.06	2.78	N.A.	66.34	0.04	14.93
		B3	0.13	89.84	7.45	2.58	2.79	N.A.	54.78	0.15	1.66
		B4	0.00	98.73	1.22	0.06	2.67	N.A.	78.65	0.05	1.25
		B5	0.00	99.21	0.73	0.06	2.66	N.A.	84.44	0.05	1.23
		B6	0.48	91.49	6.56	1.47	3.16	N.A.	64.92	0.06	1.30
		B7	3.59	89.96	6.45	0.00	2.86	N.A.	64.09	0.04	2.47
		B8	-	-	-	-	-	-	-	-	-
1988	Summer	B1	0.03	98.72	0.30	0.96	1.72	N.A.	54.71	0.04	0.85
		B2	0.52	87.66	7.19	4.44	3.10	N.A.	48.88	0.10	2.97
		B3	27.44	70.31	0.90	1.34	0.35	N.A.	46.56	-0.84	0.61
		B4	0.00	98.33	1.31	0.36	2.51	N.A.	73.05	-0.19	1.51
		B5	0.00	97.20	1.99	0.81	2.70	N.A.	81.62	0.11	1.38
		B6	0.03	89.77	9.39	0.82	3.19	N.A.	69.56	0.02	1.40
		B7	0.07	96.40	2.59	0.94	2.64	N.A.	67.52	-0.18	2.62
		B8	-	-	-	-	-	-	-	-	-
1986	Winter	B1	0.30	99.70	0.00	0.00	1.20	N.A.	68.00	<0.1	1.30
		B2	<0.1	89.60	10.40	0.00	3.00	N.A.	66.30	0.30	1.60
		B3	0.00	99.00	0.70	0.30	2.00	N.A.	65.50	-0.20	1.20
		B4	0.00	81.60	18.40	0.00	3.40	N.A.	64.50	0.30	1.10
		B5	0.00	98.60	0.60	0.80	2.80	N.A.	82.80	0.10	1.30
		B6	0.00	92.00	7.80	0.30	3.30	N.A.	69.10	0.30	1.30
		B7	0.00	91.30	8.50	0.00	3.20	N.A.	72.00	0.30	1.20
		B8	-	-	-	-	-	-	-	-	-
	Summer	B1	0.00	98.10	1.90	<0.1	1.30	N.A.	62.30	0.30	1.40
		B2	<0.1	90.70	7.60	1.70	3.00	N.A.	61.60	0.10	2.00
		B3	1.20	96.20	2.60	0.00	1.80	N.A.	61.30	<0.1	1.10
		B4	3.00	86.00	10.70	0.30	2.80	N.A.	53.30	-0.20	2.00
		B5	0.00	96.00	3.60	0.00	3.30	N.A.	76.70	0.20	1.40
		B6	0.20	88.70	10.20	0.00	3.30	N.A.	71.40	0.20	1.40
		B7	0.00	84.60	14.70	0.00	3.30	N.A.	68.90	0.20	0.90
		B8	-	-	-	-	-	-	-	-	-
1980	Winter	B1	0.00	100.00	0.00	0.00	2.53	N.A.	0.38	-0.20	1.36
		B2	0.00	96.40	1.90	1.61	2.78	N.A.	0.30	0.19	1.43
		B3	0.64	94.30	3.10	1.89	2.26	N.A.	0.66	-0.17	2.57
		B4	0.00	82.20	13.50	4.28	3.49	N.A.	0.78	0.62	2.38
		B5	0.00	97.10	2.30	0.46	2.72	N.A.	0.40	-0.08	1.23
		B6	0.00	87.10	10.70	2.23	3.38	N.A.	0.57	0.38	0.88
		B7	0.00	92.00	7.40	0.00	3.26	N.A.	0.25	0.23	2.44
		B8	0.12	92.60	6.50	0.00	2.39	N.A.	1.11	-0.59	0.49
	Summer	B1	0.00	96.70	2.70	51.00	2.55	N.A.	0.49	-0.19	1.40
		B2	0.00	72.00	23.20	4.85	3.68	N.A.	1.06	0.50	1.31
		B3	18.36	76.90	2.80	2.02	-0.72	N.A.	3.30	-0.73	0.24
		B4	0.00	96.00	2.50	1.51	2.70	N.A.	0.48	-0.05	1.60
		B5	0.00	98.10	1.30	0.60	2.53	N.A.	0.44	0.10	0.76
		B6	0.00	89.60	9.40	1.05	3.26	N.A.	0.43	0.26	0.89
		B7	0.00	91.40	6.70	1.98	3.26	N.A.	0.34	0.20	1.26
		B8	1.45	93.40	4.00	1.16	3.06	N.A.	0.34	0.10	1.48

Q9

**Appendix D-1. (Cont.).**

Year	Season	Station	Mean grain size								
			Gravel (%)	Sand (%)	Silt (%)	Clay (%)	phi	$\mu_m$	Sorting	Skewness	Kurtosis
1978	Winter	B1	2.40	83.60	14.00	5.10	1.96	N.A.	2.15	0.37	N.A.
		B2	0.00	92.20	7.80	0.80	3.02	N.A.	0.70	0.27	N.A.
		B3	0.90	91.30	7.80	1.90	2.00	N.A.	1.35	0.20	N.A.
		B4	0.10	96.80	3.10	1.00	2.82	N.A.	0.47	0.18	N.A.
		B5	0.00	88.00	12.00	0.60	3.36	N.A.	0.63	-0.06	N.A.
		B6	0.00	83.10	16.90	2.00	3.43	N.A.	0.71	-0.06	N.A.
		B7	0.10	82.30	17.60	1.60	3.42	N.A.	0.77	0.14	N.A.
		B8	-	-	-	-	-	-	-	-	-
	Summer	B1	0.00	57.21	42.79	2.30	2.99	N.A.	1.11	-0.36	N.A.
		B2	0.12	56.49	43.39	1.80	3.46	N.A.	0.62	-0.10	N.A.
		B3	0.51	51.77	47.72	0.00	2.86	N.A.	1.18	-0.27	N.A.
		B4	0.33	51.23	48.44	0.00	3.48	N.A.	0.71	-0.61	N.A.
		B5	0.00	49.19	50.81	0.55	3.50	N.A.	0.62	-0.34	N.A.
		B6	0.00	46.21	53.79	0.00	3.84	N.A.	0.39	-0.63	N.A.
		B7	0.00	54.22	45.78	0.00	3.71	N.A.	0.45	-0.57	N.A.
		B8	-	-	-	-	-	-	-	-	-

N.A. = Not Available

- = Not Sampled

## **APPENDIX E**

**Sediment chemistry by station**

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**Appendix E. Sediment chemistry by station. AES Redondo Beach L.L.C. generating station NPDES, 2001.**



**Del Mar Analytical**

MBC Applied Env. Sciences  
3000 Redhill Avenue  
Costa Mesa, CA 92626-4524  
Attention: Mike Curtis

Project ID: 01214A/RGS NPDES

Report Number: IKG0035

Sampled: 06/27/01  
Received: 07/03/01

2852 Alton Ave., Irvine, CA 92606 (949) 261-1022 FAX (949) 261-1228  
1014 E. Coldby Dr., Suite A, Colton, CA 92324 (909) 370-4667 FAX (909) 370-1046  
7277 Hayvenhurst, Suite B-12, Van Nuys, CA 91406 (818) 779-1844 FAX (818) 779-1843  
9484 Chesapeake Dr., Suite 805, San Diego, CA 92123 (858) 505-8596 FAX (858) 505-9589  
9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851

**CASE NARRATIVE**

LABORATORY NUMBER	SAMPLE DESCRIPTION	SAMPLE MATRIX	ANALYSES
IKG0035-01	B1 (I,II,III)	Solid (74.46% dry wt.)	EPA 160.3 MOD EPA 6010B
IKG0035-02	B2 (I,II,III)	Solid (55.74% dry wt.)	EPA 160.3 MOD EPA 6010B
IKG0035-03	B3 (I,II,III)	Solid (77.65% dry wt.)	EPA 160.3 MOD EPA 6010B
IKG0035-04	B4 (I,II,III)	Solid (53.33% dry wt.)	EPA 160.3 MOD EPA 6010B
IKG0035-05	B5 (I,II,III)	Solid (67.52% dry wt.)	EPA 160.3 MOD EPA 6010B
IKG0035-06	B6 (I,II,III)	Solid (60.79% dry wt.)	EPA 160.3 MOD EPA 6010B
IKG0035-07	B7 (I,II,III)	Solid (57.92% dry wt.)	EPA 160.3 MOD EPA 6010B

**SAMPLE RECEIPT:** Samples were received intact, on ice at 4°C and with chain of custody documentation.

**HOLDING TIMES:** Holding times were met.

**PRESERVATION:** Samples requiring preservation were verified prior to sample analysis.

**QA/QC CRITERIA:** All analyses met method criteria.

**OBSERVATIONS:** No significant observations were made with the exception noted under Additional Case Narrative Details.

**SUBCONTRACTED:** No analyses were subcontracted to an outside laboratory.

**Additional Case Narrative Details:**

The Nickel and Zinc results for sample B5 (I,II,III) reported on July 13, 2001 were high due to instrumental carry-over from a previous analytical run. The original extract was reanalyzed on August 8, 2001. The sample was also redigested and analyzed for confirmation purposes.

**DEL MAR ANALYTICAL, IRVINE (CA ELAP #1197)**

**Del Mar Analytical, Irvine**  
Michele Harper  
Project Manager Supervisor

*The results pertain only to the samples tested in the laboratory. This report shall not be reproduced,  
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**IKG0035 <Page 2 of 9>**

Appendix E. (Cont.).



MBC Applied Env. Sciences  
3000 Redhill Avenue  
Costa Mesa, CA 92626-4524  
Attention: Mike Curtis

Project ID: 01214A/RGS NPDES

Report Number: IKG0035

2852 Alton Ave., Irvine, CA 92606 (949) 261-1022 FAX (949) 261-1228  
1014 E. Coldby Dr., Suite A, Colton, CA 92324 (909) 370-4667 FAX (909) 370-1046  
7277 Hayvenhurst, Suite B-12, Van Nuys, CA 91406 (818) 779-1844 FAX (818) 779-1843  
9484 Chesapeake Dr., Suite 805, San Diego, CA 92123 (858) 505-8596 FAX (858) 505-9589  
9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851

Sampled: 06/27/01  
Received: 07/03/01

### METALS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
			mg/kg dry	mg/kg dry				
<b>Sample ID: IKG0035-01 (B1 (I,II,III) - Solid)</b>								
Chromium	EPA 6010B	IIG0543	1.3	9.9	1	7/5/01	7/5/01	
Copper	EPA 6010B	IIG0543	1.3	22	1	7/5/01	7/5/01	
Nickel	EPA 6010B	IIG0543	1.3	11	1	7/5/01	7/5/01	
Zinc	EPA 6010B	IIG0543	6.7	30	1	7/5/01	7/5/01	
<b>Sample ID: IKG0035-02 (B2 (I,II,III) - Solid)</b>								
Chromium	EPA 6010B	IIG0543	1.8	30	1	7/5/01	7/5/01	
Copper	EPA 6010B	IIG0543	1.8	31	1	7/5/01	7/5/01	
Nickel	EPA 6010B	IIG0543	1.8	16	1	7/5/01	7/5/01	
Zinc	EPA 6010B	IIG0543	9.0	74	1	7/5/01	7/5/01	
<b>Sample ID: IKG0035-03 (B3 (I,II,III) - Solid)</b>								
Chromium	EPA 6010B	IIG0543	1.3	13	1	7/5/01	7/5/01	
Copper	EPA 6010B	IIG0543	1.3	8.4	1	7/5/01	7/5/01	
Nickel	EPA 6010B	IIG0543	1.3	9.9	1	7/5/01	7/5/01	
Zinc	EPA 6010B	IIG0543	6.4	26	1	7/5/01	7/5/01	
<b>Sample ID: IKG0035-04 (B4 (I,II,III) - Solid)</b>								
Chromium	EPA 6010B	IIG0543	1.9	17	1	7/5/01	7/5/01	
Copper	EPA 6010B	IIG0543	1.9	5.6	1	7/5/01	7/5/01	
Nickel	EPA 6010B	IIG0543	1.9	10	1	7/5/01	7/5/01	
Zinc	EPA 6010B	IIG0543	9.4	31	1	7/5/01	7/5/01	

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Project Manager Supervisor

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Appendix E. (Cont.).



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 7277 Hayvenhurst, Suite B-12, Van Nuys, CA 91406 (818) 779-1844 FAX (818) 779-1843  
 9484 Chesapeake Dr., Suite 805, San Diego, CA 92123 (858) 505-8596 FAX (858) 505-9589  
 9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851

MBC Applied Env. Sciences  
 3000 Redhill Avenue  
 Costa Mesa, CA 92626-4524  
 Attention: Mike Curtis

Project ID: 01214A/RGS NPDES

Report Number: IKG0035

Sampled: 06/27/01  
 Received: 07/03/01

### METALS

Analyte	Method	Batch	Reporting	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
			Limit					
<b>Sample ID: IKG0035-05 (B5 (I,II,III) - Solid)</b>								
Chromium	EPA 6010B	IIG0924	1.5	13	1	7/9/01	7/9/01	
Copper	EPA 6010B	IIG0924	1.5	20	1	7/9/01	7/9/01	
Nickel	EPA 6010B	IIG0924	1.5	12	1	7/9/01	8/8/01	
Zinc	EPA 6010B	IIG0924	7.4	31	1	7/9/01	8/8/01	
<b>Sample ID: IKG0035-06 (B6 (I,II,III) - Solid)</b>								
Chromium	EPA 6010B	IIG0924	1.6	19	1	7/9/01	7/9/01	
Copper	EPA 6010B	IIG0924	1.6	9.3	1	7/9/01	7/9/01	
Nickel	EPA 6010B	IIG0924	1.6	30	1	7/9/01	7/9/01	
Zinc	EPA 6010B	IIG0924	8.2	64	1	7/9/01	7/9/01	
<b>Sample ID: IKG0035-07 (B7 (I,II,III) - Solid)</b>								
Chromium	EPA 6010B	IIG0924	1.7	16	1	7/9/01	7/9/01	
Copper	EPA 6010B	IIG0924	1.7	5.5	1	7/9/01	7/9/01	
Nickel	EPA 6010B	IIG0924	1.7	12	1	7/9/01	7/9/01	
Zinc	EPA 6010B	IIG0924	8.6	32	1	7/9/01	7/9/01	

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 Project Manager Supervisor

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Appendix E. (Cont.).



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 7277 Hayvenhurst, Suite B-12, Van Nuys, CA 91406 (818) 779-1844 FAX (818) 779-1843  
 9484 Chesapeake Dr., Suite 805, San Diego, CA 92123 (858) 505-8596 FAX (858) 505-9585  
 9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851

MBC Applied Env. Sciences  
 3000 Redhill Avenue  
 Costa Mesa, CA 92626-4524  
 Attention: Mike Curtis

Project ID: 01214A/RGS NPDES

Report Number: IKG0035

Sampled: 06/27/01  
 Received: 07/03/01

**INORGANICS**

Analyte	Method	Reporting Batch	Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
		%	%					
<b>Sample ID: IKG0035-01 (B1 (I,II,III) - Solid)</b>								
Percent Solids	EPA 160.3 MODIIG0351	0.010		74	1	7/3/01	7/3/01	
<b>Sample ID: IKG0035-02 (B2 (I,II,III) - Solid)</b>								
Percent Solids	EPA 160.3 MODIIG0351	0.010		56	1	7/3/01	7/3/01	
<b>Sample ID: IKG0035-03 (B3 (I,II,III) - Solid)</b>								
Percent Solids	EPA 160.3 MODIIG0351	0.010		78	1	7/3/01	7/3/01	
<b>Sample ID: IKG0035-04 (B4 (I,II,III) - Solid)</b>								
Percent Solids	EPA 160.3 MODIIG0351	0.010		53	1	7/3/01	7/3/01	
<b>Sample ID: IKG0035-05 (B5 (I,II,III) - Solid)</b>								
Percent Solids	EPA 160.3 MODIIG0351	0.010		68	1	7/3/01	7/3/01	
<b>Sample ID: IKG0035-06 (B6 (I,II,III) - Solid)</b>								
Percent Solids	EPA 160.3 MODIIG0351	0.010		61	1	7/3/01	7/3/01	
<b>Sample ID: IKG0035-07 (B7 (I,II,III) - Solid)</b>								
Percent Solids	EPA 160.3 MODIIG0351	0.010		58	1	7/3/01	7/3/01	

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 9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851

MBC Applied Env. Sciences  
 3000 Redhill Avenue  
 Costa Mesa, CA 92626-4524  
 Attention: Mike Curtis

Project ID: 01214A/RGS NPDES

Report Number: IKG0035

Sampled: 06/27/01  
 Received: 07/03/01

## METHOD BLANK/QC DATA

### METALS

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC %REC	%REC Limits	RPD RPD	RPD Limit	Data Qualifiers
---------	--------	-----------------	-------	-------------	---------------	-----------	-------------	---------	-----------	-----------------

Batch: I1G0543 Extracted: 07/05/01

**Blank Analyzed: 07/06/01 (I1G0543-BLK1)**

Chromium	ND	1.0	mg/kg wet
Copper	ND	1.0	mg/kg wet
Nickel	ND	1.0	mg/kg wet
Zinc	ND	5.0	mg/kg wet

**LCS Analyzed: 07/06/01 (I1G0543-BS1)**

Chromium	49.7	1.0	mg/kg wet	50.0	99.4	80-120
Copper	49.7	1.0	mg/kg wet	50.0	99.4	80-120
Nickel	49.2	1.0	mg/kg wet	50.0	98.4	80-120
Zinc	49.0	5.0	mg/kg wet	50.0	98.0	80-120

**Matrix Spike Analyzed: 07/06/01 (I1G0543-MS1)**

Chromium	75.3	1.0	mg/kg wet	50.0	26	98.6	75-125
Copper	85.6	1.0	mg/kg wet	50.0	42	87.2	75-125
Nickel	67.7	1.0	mg/kg wet	50.0	21	93.4	75-125
Zinc	138	5.0	mg/kg wet	50.0	97	82.0	75-125

**Matrix Spike Dup Analyzed: 07/06/01 (I1G0543-MSD1)**

Chromium	70.6	1.0	mg/kg wet	50.0	26	89.2	75-125	6.44	20
Copper	81.2	1.0	mg/kg wet	50.0	42	78.4	75-125	5.28	20
Nickel	64.0	1.0	mg/kg wet	50.0	21	86.0	75-125	5.62	20
Zinc	144	5.0	mg/kg wet	50.0	97	94.0	75-125	4.26	20

Batch: I1G0924 Extracted: 07/09/01

**Blank Analyzed: 07/09/01 (I1G0924-BLK1)**

Chromium	ND	1.0	mg/kg wet
Copper	ND	1.0	mg/kg wet
Nickel	ND	1.0	mg/kg wet
Zinc	ND	5.0	mg/kg wet

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MBC Applied Env. Sciences  
 3000 Redhill Avenue  
 Costa Mesa, CA 92626-4524  
 Attention: Mike Curtis

Project ID: 01214A/RGS NPDES  
 Report Number: IKG0035

Sampled: 06/27/01  
 Received: 07/03/01

## METHOD BLANK/QC DATA

### METALS

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Data Qualifiers
---------	--------	-----------------	-------	-------------	---------------	------	-------------	-----	-----------	-----------------

Batch: I1G0924 Extracted: 07/09/01

**LCS Analyzed: 07/09/01 (I1G0924-BS1)**

Chromium	47.6	1.0	mg/kg wet	50.0		95.2	80-120
Copper	47.3	1.0	mg/kg wet	50.0		94.6	80-120
Nickel	45.8	1.0	mg/kg wet	50.0		91.6	80-120
Zinc	47.2	5.0	mg/kg wet	50.0		94.4	80-120

**Matrix Spike Analyzed: 07/09/01 (I1G0924-MS1)**

Chromium	59.7	1.0	mg/kg wet	50.0	9.0	101	75-125
Copper	66.9	1.0	mg/kg wet	50.0	12	110	75-125
Nickel	54.3	1.0	mg/kg wet	50.0	5.0	98.6	75-125
Zinc	84.6	5.0	mg/kg wet	50.0	31	107	75-125

**Source: IKG0162-01**

**Matrix Spike Dup Analyzed: 07/09/01 (I1G0924-MSD1)**

Chromium	59.1	1.0	mg/kg wet	50.0	9.0	100	75-125	1.01	20
Copper	63.5	1.0	mg/kg wet	50.0	12	103	75-125	5.21	20
Nickel	52.9	1.0	mg/kg wet	50.0	5.0	95.8	75-125	2.61	20
Zinc	81.1	5.0	mg/kg wet	50.0	31	100	75-125	4.22	20

**Source: IKG0162-01**

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Attention: Mike Curtis

Project ID: 01214A/RGS NPDES

Report Number: IKG0035

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9484 Chesapeake Dr., Suite 805, San Diego, CA 92123 (858) 505-8596 FAX (858) 505-9589  
9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851

Sampled: 06/27/01

Received: 07/03/01

### METHOD BLANK/QC DATA

#### INORGANICS

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC %REC	%REC Limits	RPD RPD	RPD Limit	Data Qualifiers
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Batch: I1G0351 Extracted: 07/03/01

**Blank Analyzed: 07/03/01 (I1G0351-BLK1)**

Percent Solids ND 0.010 %

**Duplicate Analyzed: 07/03/01 (I1G0351-DUP1)**

Percent Solids 63.0 0.010 % Source: IKG0034-01

64 1.57 20

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Project Manager Supervisor

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Costa Mesa, CA 92626-4524  
Attention: Mike Curtis

Project ID: 01214A/RGS NPDES

Report Number: IKG0035

Sampled: 06/27/01  
Received: 07/03/01

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1014 E Coldby Dr., Suite A, Colton, CA 92324 (909) 370-4667 FAX (909) 370-1046  
7277 Hayvenhurst, Suite B-12, Van Nuys, CA 91406 (818) 779-1844 FAX (818) 779-1843  
9484 Chesapeake Dr., Suite 805, San Diego, CA 92123 (858) 505-8596 FAX (658) 505-9589  
9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851

## DATA QUALIFIERS AND DEFINITIONS

- ND** Analyte NOT DETECTED at or above the reporting limit or MDL, if MDL is specified.  
**NR** Not reported.  
**RPD** Relative Percent Difference

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Michele Harper  
Project Manager Supervisor

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**Appendix E-1. Yearly sediment metal concentrations, 1990 - 2001. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Metal	Station	YEAR										Mean
		1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	
Chromium ERL = 81	B1	7	4	17	13	11	13	11	13	14	9.9	11.3
	B2	25	13	25	26	22	22	30	33	17	30	24.3
	B3	10	7	14	5.7	17	9	-	9.5	17	13	11.3
	B4	12	14	18	14	14	14	8.6	9.8	12	17	13.3
	B5	11	10	13	12	10	12	-	8.9	12	13	11.3
	B6	17	13	18	15	14	18	15	18	17	19	16.4
	B7	3	10	17	14	13	18	-	1.9	2.0	16	10.5
Copper ERL = 34	B1	11.3	4.3	13.0	26.0	12.0	26	13	15	16	22	15.9
	B2	18.0	10.0	14.0	21.0	18.0	19	31	30	8.8	31	20.1
	B3	5.0	3.8	15.0	3.0	7.6	4.1	-	4.7	8.8	8.4	6.7
	B4	3.7	4.6	4.4	3.9	3.6	3.2	2.4	2.4	3.1	5.6	3.7
	B5	6.5	2.5	2.9	2.8	2.9	1.9	-	2.1	2.2	20	4.9
	B6	3.5	3.6	3.9	3.5	3.5	2.9	2.1	2.9	2.8	9.3	3.8
	B7	1.0	3.2	3.2	2.9	2.6	1.8	-	1.4	ND	5.5	2.4
Nickel ERL = 21	B1	4.0	2.1	15.0	18.0	6.4	9.2	7.2	8.8	6.8	11	8.9
	B2	11.8	7.2	14.0	14.0	11	11	17	16.0	11	16	12.9
	B3	5.1	4.2	8.8	3.3	15	4	-	6	11	9.9	7.5
	B4	6.6	7.5	9.4	7.2	10	6.8	5.2	14	6.9	10	8.4
	B5	5.6	5.3	5.9	6.6	5.6	6	-	4.4	6.9	12	6.5
	B6	8.0	6.8	7.1	7.6	6.9	7.7	6.9	8.2	8.6	30	9.8
	B7	1.2	5.1	7.4	7.5	6.6	7.3	-	ND	ND	12	5.2
Zinc ERL = 150	B1	16	9	30	29	18	27	30	28	30	30	24.7
	B2	46	25	43	52	41	46	88	76	34	74	52.5
	B3	16	11	70	11	25	30	-	19	30	26	26.5
	B4	19	22	27	23	20	26	20	20	21	31	22.9
	B5	15	15	18	17	15	20	-	18	19	31	18.7
	B6	23	19	22	21	19	25	26	25	24	64	26.8
	B7	4	14	20	19	17	22	-	6.7	ND	32	15.0
Fines	B1	2.85	1.20	3.46	8.31	11.94	5.48	7.65	11.42	12.9	3.2	6.8
	B2	8.26	14.00	14.66	26.10	21.76	21.28	28.10	23.20	49.1	48.1	25.5
	B3	6.10	2.05	52.56	1.47	3.82	1.86	-	3.20	7.2	2.7	9.0
	B4	5.88	5.36	4.76	2.87	2.29	1.54	3.69	3.13	5.5	4.3	3.9
	B5	2.37	2.56	1.21	6.53	3.89	7.91	-	3.14	5.5	3.9	4.1
	B6	7.15	6.17	6.31	5.16	5.52	7.01	6.87	6.98	9.0	6.6	6.7
	B7	0.95	24.00	3.73	7.30	8.04	6.30	-	0.74	2.4	10.1	7.1

- = not sampled

ND = below the detection limit (for calculations ND = 0)

ERL = Effects Range Low

## **APPENDIX F**

**Mussel tissue chemistry by station**

---

**Appendix F. Mussel chemistry by station. AES Redondo Beach L.L.C. generating station NPDES, 2001.**



2867 Alton Ave. Irvine, CA 92606 (949) 261-1022 FAX (949) 261-1278  
 10141 C. Gentry Dr., Suite A, Colton, CA 92324 (909) 370-4667 FAX (909) 370-1046  
 18625 Sherman Way, Suite C-11, Van Nuys, CA 91406 (818) 779-1844 FAX (818) 779-1843  
 14884 Chesapeake Dr. Suite P05, San Diego, CA 92123 (619) 505-9596 FAX (619) 505-9693  
 9830 South 51st St. Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851

MBC Applied Env. Sciences  
 3000 Redhill Avenue  
 Costa Mesa, CA 92626-4524  
 Attention: Mike Curtis

Project ID: 01214A AES RGS NPDES

Report Number: IKJ0192

Sampled: 08/10/01  
 Received: 10/04/01

## METALS

Analyte	Method	Batch	Reporting	Sample	Dilution	Date	Date	Data
			Limit	Result	Factor	Extracted	Analyzed	Qualifiers
			mg/kg dry	mg/kg dry				
<b>Sample ID: IKJ0192-01 (MT RB-I - Soil)</b>								
Chromium	EPA 6010B	I1J0951	4.9	ND	1	10/9/01	10/10/01	
Copper	EPA 6010B	I1J0951	4.9	ND	1	10/9/01	10/10/01	
Nickel	EPA 6010B	I1J0951	4.9	ND	1	10/9/01	10/10/01	
Zinc	EPA 6010B	I1J0951	24	58	1	10/9/01	10/10/01	
<b>Sample ID: IKJ0192-02 (MT RB-II - Soil)</b>								
Chromium	EPA 6010B	I1J0951	4.7	ND	1	10/9/01	10/10/01	
Copper	EPA 6010B	I1J0951	4.7	ND	1	10/9/01	10/10/01	
Nickel	EPA 6010B	I1J0951	4.7	ND	1	10/9/01	10/10/01	
Zinc	EPA 6010B	I1J0951	24	82	1	10/9/01	10/10/01	
<b>Sample ID: IKJ0192-03 (MT RB-III - Soil)</b>								
Chromium	EPA 6010B	I1J0951	4.6	ND	1	10/9/01	10/10/01	
Copper	EPA 6010B	I1J0951	4.6	5.6	1	10/9/01	10/10/01	
Nickel	EPA 6010B	I1J0951	4.6	ND	1	10/9/01	10/10/01	
Zinc	EPA 6010B	I1J0951	23	53	1	10/9/01	10/10/01	
<b>Sample ID: IKJ0192-04 (MT MP-I - Soil)</b>								
Chromium	EPA 6010B	I1J0951	5.2	ND	1	10/9/01	10/10/01	
Copper	EPA 6010B	I1J0951	5.2	ND	1	10/9/01	10/10/01	
Nickel	EPA 6010B	I1J0951	5.2	ND	1	10/9/01	10/10/01	
Zinc	EPA 6010B	I1J0951	26	45	1	10/9/01	10/10/01	

**Del Mar Analytical, Irvine**  
 Xuan Huong Dang  
 Project Manager

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 16625 Sherman Way, Suite C-11, Van Nuys, CA 91406 (818) 779-1844 FAX (818) 779-1100  
 9484 Chesapeake Dr., Suite 805, San Diego, CA 92123 (619) 505-9596 FAX (619) 505-9596  
 9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0043

MBC Applied Env. Sciences  
 3000 Redhill Avenue  
 Costa Mesa, CA 92626-4524  
 Attention: Mike Curtis

Project ID: 01214A AES RGS NPDES

Report Number: IKJ0192

Sampled: 08/10/01  
 Received: 10/04/01

## METALS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
				mg/kg dry	mg/kg dry			
<b>Sample ID: IKJ0192-05 (MT MP-II - Soil)</b>								
Chromium	EPA 6010B	I1J0951	4.7	ND	1	10/9/01	10/10/01	
Copper	EPA 6010B	I1J0951	4.7	5.3	1	10/9/01	10/10/01	
Nickel	EPA 6010B	I1J0951	4.7	ND	1	10/9/01	10/10/01	
Zinc	EPA 6010B	I1J0951	23	68	1	10/9/01	10/10/01	
<b>Sample ID: IKJ0192-06 (MT MP-III - Soil)</b>								
Chromium	EPA 6010B	I1J0951	4.5	ND	1	10/9/01	10/10/01	
Copper	EPA 6010B	I1J0951	4.5	5.7	1	10/9/01	10/10/01	
Nickel	EPA 6010B	I1J0951	4.5	ND	1	10/9/01	10/10/01	
Zinc	EPA 6010B	I1J0951	23	48	1	10/9/01	10/10/01	

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**Appendix F. (Cont.).**

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3000 Redhill Avenue  
Costa Mesa, CA 92626-4524  
Attention: Mike Curtis

Project ID: 01214A AES RGS NPDES

Report Number: IKJ0192

Sampled: 08/10/01  
Received: 10/04/01

## INORGANICS

Analyte	Method	Batch	Reporting	Sample	Dilution	Date	Date	Data Qualifiers
			Limit			Factor	Extracted	
			%	%				
<b>Sample ID: IKJ0192-01 (MT RB-I - Soil)</b>								
Percent Solids	EPA 160.3 MOD I1J0550		0.010	20	1	10/5/01	10/5/01	H3
<b>Sample ID: IKJ0192-02 (MT RB-II - Soil)</b>								
Percent Solids	EPA 160.3 MOD I1J0550		0.010	21	1	10/5/01	10/5/01	H3
<b>Sample ID: IKJ0192-03 (MT RB-III - Soil)</b>								
Percent Solids	EPA 160.3 MOD I1J0550		0.010	22	1	10/5/01	10/5/01	H3
<b>Sample ID: IKJ0192-04 (MT MP-I - Soil)</b>								
Percent Solids	EPA 160.3 MOD I1J0550		0.010	19	1	10/5/01	10/5/01	H3
<b>Sample ID: IKJ0192-05 (MT MP-II - Soil)</b>								
Percent Solids	EPA 160.3 MOD I1J0550		0.010	21	1	10/5/01	10/5/01	H3
<b>Sample ID: IKJ0192-06 (MT MP-III - Soil)</b>								
Percent Solids	EPA 160.3 MOD I1J0550		0.010	22	1	10/5/01	10/5/01	H3

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 1655 Sherman Way, Suite C-11, Van Nuys, CA 91406 (818) 779-1844 FAX (818) 779-1  
 9484 Chesapeake Dr., Suite 805, San Diego, CA 92123 (619) 505-9596 FAX (619) 505-9  
 9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0

MBC Applied Env. Sciences  
 3000 Redhill Avenue  
 Costa Mesa, CA 92626-4524  
 Attention: Mike Curtis

Project ID: 01214A AES RGS NPDES  
 Report Number: IKJ0192

Sampled: 08/10/01  
 Received: 10/04/01

## METHOD BLANK/QC DATA

### METALS

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC %REC	%REC Limits	RPD RPD	RPD Limit	Data Qualifiers
<b>Batch: I1J0951 Extracted: 10/09/01</b>										
<b>Blank Analyzed: 10/10/01 (I1J0951-BLK1)</b>										
Chromium ND 1.0 mg/kg wet										
Copper ND 1.0 mg/kg wet										
Nickel ND 1.0 mg/kg wet										
Zinc ND 5.0 mg/kg wet										
<b>LCS Analyzed: 10/11/01 (I1J0951-BS1)</b>										
Chromium	54.2	1.0	mg/kg wet	50.0		108	80-120			
Copper	52.1	1.0	mg/kg wet	50.0		104	80-120			
Nickel	53.3	1.0	mg/kg wet	50.0		107	80-120			
Zinc	52.6	5.0	mg/kg wet	50.0		105	80-120			
<b>Matrix Spike Analyzed: 10/10/01 (I1J0951-MS1)</b>										
Chromium 48.7 1.0 mg/kg wet 50.0 9.0 79.4 75-125										
Copper 46.6 1.0 mg/kg wet 50.0 6.5 80.2 75-125										
Nickel 45.8 1.0 mg/kg wet 50.0 6.4 78.8 75-125										
Zinc 64.8 5.0 mg/kg wet 50.0 29 71.6 75-125										
<b>Matrix Spike Dup Analyzed: 10/10/01 (I1J0951-MSD1)</b>										
Chromium 52.8 1.0 mg/kg wet 50.0 9.0 87.6 75-125 8.08 20										
Copper 51.0 1.0 mg/kg wet 50.0 6.5 89.0 75-125 9.02 20										
Nickel 49.7 1.0 mg/kg wet 50.0 6.4 86.6 75-125 8.17 20										
Zinc 69.9 5.0 mg/kg wet 50.0 29 81.8 75-125 7.57 20										

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**Appendix F. (Cont.).**

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Costa Mesa, CA 92626-4524  
Attention: Mike Curtis

Project ID: 01214A AES RGS NPDES

Report Number: IKJ0192

Sampled: 08/10/01  
Received: 10/04/01

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1014 E. Colley Dr., Suite A, Colton, CA 92324 (809) 370-4667 FAX (909) 370-1044  
16525 Sherman Way, Suite C-11, Van Nuys, CA 91406 (818) 777-1844 FAX (818) 779-1843  
9481 Chesapeake Dr., Suite 805, San Diego, CA 92123 (619) 505-9596 FAX (619) 505-9531  
9830 South 51st St., Suite B-120, Phoenix, AZ 85064 (480) 785-0043 FAX (480) 785-0851

## METHOD BLANK/QC DATA

### INORGANICS

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC %REC	%REC Limits	RPD RPD	RPD Limit	Data Qualifiers
<b>Batch: I1J0550 Extracted: 10/05/01</b>										
Blank Analyzed: 10/05/01 (I1J0550-BLK1)										
Percent Solids	ND	0.010	%							
<b>Duplicate Analyzed: 10/05/01 (I1J0550-DUP1)</b>										
Percent Solids	19.6	0.010	%		Source: IKJ0128-01	20		2.02	20	

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Attention: Mike Curtis

Project ID: 01214A AES RGS NPDES

Report Number: IKJ0192

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1014 E. Cooley Dr., Suite A, Colton, CA 92324  
16526 Sherman Way, Suite C-11, Van Nuys, CA 91406  
94841 Chesapeake Dr., Suite 806, San Diego, CA 92123  
9830 South 51st St., Suite B-120, Phoenix, AZ 85044  
(949) 261-1022 FAX (949) 261-1  
(909) 370-4667 FAX (909) 370-1  
(818) 779-1844 FAX (818) 779-1  
(619) 505-9596 FAX (619) 505-9  
(480) 795-0043 FAX (480) 785-0

Sampled: 08/10/01  
Received: 10/04/01

**DATA QUALIFIERS AND DEFINITIONS**

- H3** Sample was received and analyzed past holding time.  
**M2** The MS and/or MSD were below the acceptance limits due to sample matrix interference. See Blank Spike (LCS).  
**ND** Analyte NOT DETECTED at or above the reporting limit or MDL, if MDL is specified.  
**NR** Not reported.  
**RPD** Relative Percent Difference

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 9484 Chesapeake Dr., Suite 805, San Diego, CA 92123 (658) 505-8596 FAX (658) 505-9689  
 9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851  
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MBC Applied Env. Sciences  
 3000 Redhill Avenue  
 Costa Mesa, CA 92626-4524  
 Attention: Mike Curtis

Project ID: 01204A Catalina NPDES

Report Number: IKJ1098

Sampled: 10/19/01

Received: 10/26/01

### METALS

Analyte	Method	Batch	Reporting	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
			Limit					
<b>Sample ID: IKJ1098-04 (MT-MNC I - Solid)</b>								
Chromium	EPA 6010B	I1J3081	7.9	ND	1	10/30/01	10/31/01	
Copper	EPA 6010B	I1J3081	7.9	13	1	10/30/01	10/31/01	
Nickel	EPA 6010B	I1J3081	7.9	ND	1	10/30/01	10/31/01	
Zinc	EPA 6010B	I1J3081	40	270	1	10/30/01	10/31/01	
<b>Sample ID: IKJ1098-05 (MT-MNC II - Solid)</b>								
Chromium	EPA 6010B	I1J3140	7.4	ND	1	10/31/01	11/2/01	
Copper	EPA 6010B	I1J3140	7.4	16	1	10/31/01	11/2/01	
Nickel	EPA 6010B	I1J3140	7.4	ND	1	10/31/01	11/2/01	
Zinc	EPA 6010B	I1J3140	37	170	1	10/31/01	11/2/01	
<b>Sample ID: IKJ1098-06 (MT-MNC III - Solid)</b>								
Chromium	EPA 6010B	I1J3140	9.5	ND	1	10/31/01	11/2/01	
Copper	EPA 6010B	I1J3140	9.5	16	1	10/31/01	11/2/01	
Nickel	EPA 6010B	I1J3140	9.5	ND	1	10/31/01	11/2/01	
Zinc	EPA 6010B	I1J3140	47	250	1	10/31/01	11/2/01	

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MBC Applied Env. Sciences  
3000 Redhill Avenue  
Costa Mesa, CA 92626-4524  
Attention: Mike Curtis

Project ID: 01204A Catalina NPDES  
Report Number: IKJ1098

Sampled: 10/19/01  
Received: 10/26/01

### INORGANICS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifier
			%	%				
<b>Sample ID: IKJ1098-04 (MT-MNC I - Solid)</b>								
Percent Solids	EPA 160.3 MOD I1J2975		0.010	13	1	10/29/01	10/29/01	
<b>Sample ID: IKJ1098-05 (MT-MNC II - Solid)</b>								
Percent Solids	EPA 160.3 MOD I1J2975		0.010	14	1	10/29/01	10/29/01	
<b>Sample ID: IKJ1098-06 (MT-MNC III - Solid)</b>								
Percent Solids	EPA 160.3 MOD I1J2975		0.010	11	1	10/29/01	10/29/01	

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 9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851  
 2520 E. Sunset Rd #3, Las Vegas, NV 89120 (702) 798-3620 FAX (702) 798-3621

MBC Applied Env. Sciences  
 3000 Redhill Avenue  
 Costa Mesa, CA 92626-4524  
 Attention: Mike Curtis

Project ID: 01204A Catalina NPDES

Report Number: IKJ1098

Sampled: 10/19/01

Received: 10/26/01

**METHOD BLANK/QC DATA****METALS**

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC %REC Limits	RPD RPD Limit	Data Qualifiers
---------	--------	-----------------	-------	-------------	---------------	------------------	---------------	-----------------

**Batch: I1J3081 Extracted: 10/30/01****Blank Analyzed: 11/01/01 (I1J3081-BLK1)**

Chromium	ND	1.0	mg/kg wet
Copper	ND	1.0	mg/kg wet
Nickel	ND	1.0	mg/kg wet
Zinc	ND	5.0	mg/kg wet

**LCS Analyzed: 10/31/01 (I1J3081-BS1)**

Chromium	49.8	1.0	mg/kg wet	50.0	100	80-120
Copper	46.3	1.0	mg/kg wet	50.0	93	80-120
Nickel	48.2	1.0	mg/kg wet	50.0	96	80-120
Zinc	48.2	5.0	mg/kg wet	50.0	96	80-120

**Matrix Spike Analyzed: 10/31/01 (I1J3081-MS1)**

Chromium	55.3	1.0	mg/kg wet	50.0	9.1	92	75-125
Copper	51.4	1.0	mg/kg wet	50.0	4.1	95	75-125
Nickel	54.1	1.0	mg/kg wet	50.0	7.0	94	75-125
Zinc	64.4	5.0	mg/kg wet	50.0	17	95	75-125

**Matrix Spike Dup Analyzed: 10/31/01 (I1J3081-MSD1)**

Chromium	55.2	1.0	mg/kg wet	50.0	9.1	92	75-125	0	20
Copper	50.6	1.0	mg/kg wet	50.0	4.1	93	75-125	2	20
Nickel	52.7	1.0	mg/kg wet	50.0	7.0	91	75-125	3	20
Zinc	63.5	5.0	mg/kg wet	50.0	17	93	75-125	1	20

**Batch: I1J3140 Extracted: 10/31/01****Blank Analyzed: 11/02/01 (I1J3140-BLK1)**

Chromium	ND	1.0	mg/kg wet
Copper	ND	1.0	mg/kg wet
Nickel	ND	1.0	mg/kg wet
Zinc	ND	5.0	mg/kg wet

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Report Number: IKJ1098

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1014 E. Cooley Dr., Suite A, Colton, CA 92324 (909) 370-4667 FAX (909) 370-1072  
7277 Hayvenhurst, Suite B-12, Van Nuys, CA 91406 (818) 779-1844 FAX (818) 779-1844  
9484 Chesapeake Dr., Suite 805, San Diego, CA 92123 (858) 505-8596 FAX (858) 505-9696  
9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0826  
2520 E. Sunset Rd. #3, Las Vegas, NV 89120 (702) 798-3620 FAX (702) 798-3620

Sampled: 10/19/01  
Received: 10/26/01

## METHOD BLANK/QC DATA

### METALS

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD RPD	RPD Limit	Data Qualifiers
<b><u>Batch: I1J3140 Extracted: 10/31/01</u></b>										
<b>LCS Analyzed: 11/02/01 (I1J3140-BS1)</b>										
Chromium	51.8	1.0	mg/kg wet	50.0		104	80-120			
Copper	49.5	1.0	mg/kg wet	50.0		99	80-120			
Nickel	49.8	1.0	mg/kg wet	50.0		100	80-120			
Zinc	49.3	5.0	mg/kg wet	50.0		99	80-120			
<b>Matrix Spike Analyzed: 11/03/01 (I1J3140-MS1)</b>										
Chromium	56.3	1.0	mg/kg wet	50.0	18	77	75-125			
Copper	60.0	1.0	mg/kg wet	50.0	21	78	75-125			
Nickel	50.6	1.0	mg/kg wet	50.0	13	75	75-125			
Zinc	104	5.0	mg/kg wet	50.0	68	72	75-125			M2
<b>Matrix Spike Dup Analyzed: 11/03/01 (I1J3140-MSD1)</b>										
Chromium	54.9	1.0	mg/kg wet	50.0	18	74	75-125	3	20	M2
Copper	58.4	1.0	mg/kg wet	50.0	21	75	75-125	3	20	
Nickel	49.6	1.0	mg/kg wet	50.0	13	73	75-125	2	20	M2
Zinc	101	5.0	mg/kg wet	50.0	68	66	75-125	3	20	M2

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Attention: Mike Curtis

Project ID: 01204A Catalina NPDES

Report Number: IKJ1098

Sampled: 10/19/01  
Received: 10/26/01

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7277 Hayvenhurst Suite B-12, Van Nuys, CA 91406 (818) 779-1844 FAX (818) 779-1843  
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9930 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851  
2520 E. Sunset Rd. #3, Las Vegas, NV 89120 (702) 798-3620 FAX (702) 798-3621

### METHOD BLANK/QC DATA

#### INORGANICS

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC %REC	%REC Limits	RPD RPD	RPD Limit	Data Qualifiers
<b><u>Batch: I1J2975 Extracted: 10/29/01</u></b>										
<b>Blank Analyzed: 10/29/01 (I1J2975-BLK1)</b>										
Percent Solids	ND	0.010	%							
<b>Duplicate Analyzed: 10/29/01 (I1J2975-DUP1)</b>										
Percent Solids	12.4	0.010	%			Source: IKJ0978-01RE1	12		3	20

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Attention: Mike Curtis

Project ID: 01204A Catalina NPDES

Report Number: IKJ1098

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Sampled: 10/19/01  
Received: 10/26/01

## DATA QUALIFIERS AND DEFINITIONS

- M2** The MS and/or MSD were below the acceptance limits due to sample matrix interference. See Blank Spike (LCS).  
**ND** Analyte NOT DETECTED at or above the reporting limit or MDL, if MDL is specified.  
**NR** Not reported.  
**RPD** Relative Percent Difference

**Del Mar Analytical, Irvine**  
Xuan Huong Dang  
Project Manager

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 7277 Hayvenhurst, Suite B-12, Van Nuys, CA 91406 (818) 779-1844 FAX (818) 779-1843  
 9484 Chesapeake Dr., Suite 805, San Diego, CA 92123 (858) 505-8599 FAX (858) 505-9689  
 9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851  
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MBC Applied Env. Sciences  
 3000 Redhill Avenue  
 Costa Mesa, CA 92626-4524  
 Attention: Mike Curtis

Project ID: 01214A Manhattan Pier NPDES

Sampled: 08/10/01

Report Number: IKJ0192

Received: 10/04/01

## METALS

Analyte	Method	Batch	Reporting	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
			Limit			mg/kg dry	mg/kg dry	
<b>Sample ID: IKJ0192-04 (MT MP-I - Soil)</b>								
Chromium	EPA 6010B	I1J0951	5.2	ND	1	10/9/01	10/10/01	
Copper	EPA 6010B	I1J0951	5.2	ND	1	10/9/01	10/10/01	L2
Nickel	EPA 6010B	I1J0951	5.2	ND	1	10/9/01	10/10/01	
Zinc	EPA 6010B	I1J0951	26	45	1	10/9/01	10/10/01	
<b>Sample ID: IKJ0192-05 (MT MP-II - Soil)</b>								
Chromium	EPA 6010B	I1J0951	4.7	ND	1	10/9/01	10/10/01	
Copper	EPA 6010B	I1J0951	4.7	5.3	1	10/9/01	10/10/01	L2
Nickel	EPA 6010B	I1J0951	4.7	ND	1	10/9/01	10/10/01	
Zinc	EPA 6010B	I1J0951	23	68	1	10/9/01	10/10/01	
<b>Sample ID: IKJ0192-06 (MT MP-III - Soil)</b>								
Chromium	EPA 6010B	I1J0951	4.5	ND	1	10/9/01	10/10/01	
Copper	EPA 6010B	I1J0951	4.5	5.7	1	10/9/01	10/10/01	L2
Nickel	EPA 6010B	I1J0951	4.5	ND	1	10/9/01	10/10/01	
Zinc	EPA 6010B	I1J0951	23	48	1	10/9/01	10/10/01	

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MBC Applied Env. Sciences  
3000 Redhill Avenue  
Costa Mesa, CA 92626-4524  
Attention: Mike Curtis

Project ID: 01214A Manhattan Pier NPDES  
Report Number: IKJ0192

Sampled: 08/10/01  
Received: 10/04/01

### INORGANICS

Analyte	Method	Batch	Reporting	Sample	Dilution	Date	Date	Data
			Limit			Extracted	Analyzed	Qualifier
<b>Sample ID: IKJ0192-04 (MT MP-I - Soil)</b>								
Percent Solids	EPA 160.3 MOD I1J0550		0.010	19	1	10/5/01	10/5/01	H3
<b>Sample ID: IKJ0192-05 (MT MP-II - Soil)</b>								
Percent Solids	EPA 160.3 MOD I1J0550		0.010	21	1	10/5/01	10/5/01	H3
<b>Sample ID: IKJ0192-06 (MT MP-III - Soil)</b>								
Percent Solids	EPA 160.3 MOD I1J0550		0.010	22	1	10/5/01	10/5/01	H3

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Appendix F. (Cont.).



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Sampled: 08/10/01

Received: 10/04/01

## METHOD BLANK/QC DATA

### METALS

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC %REC Limits	RPD RPD Limit	Data Qualifiers
<b><u>Batch: I1J0951 Extracted: 10/09/01</u></b>								
<b>Blank Analyzed: 10/10/01 (I1J0951-BLK1)</b>								
Chromium	ND	1.0	mg/kg wet					
Copper	ND	1.0	mg/kg wet					
Nickel	ND	1.0	mg/kg wet					
Zinc	ND	5.0	mg/kg wet					
<b>LCS Analyzed: 10/10/01 (I1J0951-BS1)</b>								
Chromium	42.4	1.0	mg/kg wet	50.0	85	80-120		
Copper	39.7	1.0	mg/kg wet	50.0	79	80-120		L2
Nickel	41.4	1.0	mg/kg wet	50.0	83	80-120		
Zinc	40.6	5.0	mg/kg wet	50.0	81	80-120		
<b>Matrix Spike Analyzed: 10/10/01 (I1J0951-MS1)</b>								
Chromium	48.7	1.0	mg/kg wet	50.0	9.0	79	75-125	
Copper	46.6	1.0	mg/kg wet	50.0	6.5	80	75-125	
Nickel	45.8	1.0	mg/kg wet	50.0	6.4	79	75-125	
Zinc	64.8	5.0	mg/kg wet	50.0	29	72	75-125	M2
<b>Matrix Spike Dup Analyzed: 10/10/01 (I1J0951-MSD1)</b>								
Chromium	52.8	1.0	mg/kg wet	50.0	9.0	88	75-125	8
Copper	51.0	1.0	mg/kg wet	50.0	6.5	89	75-125	9
Nickel	49.7	1.0	mg/kg wet	50.0	6.4	87	75-125	8
Zinc	69.9	5.0	mg/kg wet	50.0	29	82	75-125	20

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**Appendix F. (Cont.).**



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**METHOD BLANK/QC DATA**

**INORGANICS**

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD RPD	Data Limit	Data Qualifiers
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**Batch: I1J0550 Extracted: 10/05/01**

**Blank Analyzed: 10/05/01 (I1J0550-BLK1)**

Percent Solids ND 0.010 %

**Duplicate Analyzed: 10/05/01 (I1J0550-DUP1)**

Percent Solids 19.6 0.010 % Source: IKJ0128-01 20 2 20

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Report Number: IKJ0192

Sampled: 08/10/01

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## DATA QUALIFIERS AND DEFINITIONS

- H3** Sample was received and analyzed past holding time.
- L2** Laboratory Control Sample recovery was below method control limits. See Corrective Action Report.
- M2** The MS and/or MSD were below the acceptance limits due to sample matrix interference. See Blank Spike (**LCS**).
- ND** Analyte NOT DETECTED at or above the reporting limit or MDL, if MDL is specified.
- NR** Not reported.
- RPD** Relative Percent Difference

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**Appendix F-1. Yearly bay mussel tissue metal concentrations (mg/dry kg). AES Redondo Beach L.L.C. generating station NPDES, 2001.**

	Chromium (ERL = 81)					Copper (ERL = 34)					Nickel (ERL = 21)					Zinc (ERL = 150)				
	Rep 1	Rep 2	Rep 3	Mean	S.D.	Rep 1	Rep 2	Rep 3	Mean	S.D.	Rep 1	Rep 2	Rep 3	Mean	S.D.	Rep 1	Rep 2	Rep 3	Mean	S.D.
Units 5 & 6																				
2000	ND	ND	ND	ND	-	9.6	8.6	14	10.7	2.9	ND	ND	ND	ND	-	120.0	110.0	130.0	120.0	10.0
Units 7 & 8																				
2001	ND	ND	ND	ND	-	ND	ND	5.6	1.9	3.2	ND	ND	ND	ND	-	58	82	53	64	15.5
2000	ND	ND	ND	ND	-	7.2	6.1	15.0	9.4	4.9	ND	ND	ND	ND	-	150.0	120.0	310.0	193.3	102.1
1999	ND	ND	ND	ND	-	5.4	5.8	8.5	6.6	1.7	5.0	7.0	ND	4.0	3.6	120.0	140.0	120.0	126.7	11.5
1993	ND	ND	ND	ND	-	3.8	4.2	4.2	4.1	0.2	ND	ND	ND	ND	-	75.0	63.0	70.0	69.3	6.0
1992	ND	ND	ND	ND	-	5.0	3.8	5.0	4.6	0.7	ND	ND	ND	ND	-	64.0	38.0	50.0	50.7	13.0
1991	ND	ND	ND	ND	-	9.1	21.0	8.0	12.7	7.2	ND	ND	ND	ND	-	91.0	100.0	72.0	87.7	14.3
1990	2.8	3.3	4.1	3.4	0.7	10.0	7.5	8.1	8.5	1.3	14.4	3.1	8.1	8.5	5.7	93.8	87.5	87.5	89.6	3.6
Hermosa Beach Pier																				
2001*	ND	ND	ND	ND	-	ND	5.3	5.7	3.7	3.2	ND	ND	ND	ND	-	45	68	48	54	12.5
2000	ND	ND	ND	ND	-	6.0	6	8.7	6.8	1.7	ND	ND	ND	ND	-	82.0	75.0	91.0	82.7	8.0
1999	ND	ND	ND	ND	-	6.3	ND	ND	2.1	3.6	ND	ND	ND	ND	-	160.0	120.0	90.0	123.3	35.1
1993	ND	ND	ND	ND	-	5.7	4.2	5.5	5.1	0.8	ND	ND	ND	ND	-	86.0	64.0	80.0	76.7	11.4
1992	ND	ND	ND	ND	-	5.0	5.9	7.7	6.2	1.4	ND	ND	ND	ND	-	50.0	59.0	73.0	60.7	11.6
1991	ND	ND	ND	ND	-	5.7	6.5	7.0	6.4	0.7	ND	ND	ND	ND	-	61.0	69.0	70.0	66.7	4.9
1990	2.2	3.2	3.2	2.9	0.6	3.9	4.2	5.2	4.4	0.7	ND	ND	2.9	2.9	-	53.3	83.3	77.8	71.5	16.0

\*Note: Samples in 2001 were collected at Manhattan Beach Pier

ND = Below the detection limit (for calculations ND = 0).

ERL = Effects Range Low

## **APPENDIX G**

**Infauna data by station**

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**Appendix G-1. Infaunal master species list. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

PHYLUM Subphylum or Class Species	PHYLUM Subphylum or Class Species
<b>CNIDARIA</b> Anthozoa Actiniaria <i>Edwardsia</i> sp G MEC 1992 <sup>1</sup> <i>Pennatulacea</i> <sup>2</sup> <i>Scolanthus</i> sp A SCAMIT 1983 <i>Zaolitus actius</i>	<b>MOLLUSCA (Cont.)</b> Gastropoda <i>Turbonilla</i> sp F MBC 1971
<b>PLATYHELMINTHES</b> Turbellaria <i>Leptoplaniidae</i> sp A MEC 1988 <i>Stylochoplana</i> sp <sup>3</sup>	<b>SIPUNCULA</b> Phascolosomatidea <i>Apionsoma misakianum</i> <sup>16</sup> Sipuncula
<b>NEMERTEA</b> Anopla <i>Carinoma mutabilis</i> Lineidae <i>Tubulanus nothus</i> <i>Tubulanus polymorphus</i> <sup>4</sup> Enopla <i>Amphiporus imparispinosus</i> Hoplonemertea sp B MEC 1988 <i>Monostylifera</i> sp SD 1 Pt. Loma 1995 <i>Paranemertes californica</i> <sup>5</sup> <i>Tetrastemma</i> sp A SCAMIT 1995 <i>Zygonemertes virescens</i> Uncertain Nemertea	<b>ECHIURA</b> Echiura
<b>NEMATODA</b> Nematoda	<b>ANNELIDA</b> Polychaeta <i>Amaeana occidentalis</i> <i>Ampharete labrops</i> <i>Aphelochaeta glandaria</i> <sup>17</sup> <i>Apopriionospio pygmaea</i> <i>Aricidea (Acmina) catherinae</i> <sup>18</sup> <i>Aricidea (Acmina) horikoshii</i> <sup>19</sup> <i>Armandia brevis</i> <sup>20</sup> Autolytinae <i>Capitella capitata</i> Cmplx <i>Cauferiella elata</i> <i>Chaetozone columbiana</i> <i>Chaetozone setosa</i> Cmplx <sup>21</sup> <i>Chone minuta</i> <i>Chone mollis</i> <i>Chone</i> sp SD 1 Pt. Loma 1997 Cirratulidae <i>Cirratulus cirratus</i> <i>Cossura</i> sp A Phillips 1987 <i>Diopatra ornata</i> <i>Displo uncinata</i> <i>Dorvillea (Schistomerings) annulata</i> <sup>22</sup> <i>Eteone californica</i> Euclymeninae sp A SCAMIT 1987 <i>Eumida longicornuta</i> <i>Exogone lourei</i> <i>Glycera americana</i> <i>Glycera macrobranchia</i> <sup>23</sup> <i>Glycera nana</i> <sup>24</sup> <i>Glycinde armigera</i> <i>Goniada littorea</i> <i>Halosydna johnsoni</i> <i>Halosydna brevisetosa</i> <i>Hesionella mccullochae</i> <i>Hydroides gracilis</i> <i>Laonice cirrata</i> <i>Leitoscoloplos pugettensis</i> <sup>25</sup> <i>Lumbrineris japonica</i> <i>Lysippe</i> sp A Williams 1985 <i>Magelona pitelkai</i> <i>Magelona sacculata</i> Maldanidae <i>Malmgreniella macginittiei</i> <i>Malmgreniella</i> sp A SCAMIT 1997 <i>Mediomastus acutus</i> <i>Mediomastus ambiseta</i> <sup>26</sup> <i>Mediomastus californiensis</i> <sup>26</sup> <i>Megalomma pigmentum</i> <i>Melinna oculata</i> <i>Microphthalmus hystric</i> <i>Micropodarke dubia</i> <i>Monticellina cryptica</i> <sup>27</sup> <i>Naineris dendritica</i> <i>Neosabellaria cementarium</i> <i>Nephtys caecoides</i> <i>Nephtys cornuta</i> <sup>28</sup> <i>Nereis provera</i> <i>Notomastus hemipodus</i> <i>Notomastus</i> sp A SCAMIT 2001 <sup>29</sup> <i>Odontosyllis phosphorea</i> Onuphidae <i>Onuphis</i> sp 1 Pt. Loma 1983 <i>Ophiodromus pugettensis</i> <i>Owenia collaris</i> <sup>30</sup> <i>Paleanotus bellis</i> <i>Paradoneis lyra</i>
<b>Gastropoda</b> <i>Acteocina culicella</i> <sup>10</sup> <i>Acteocina harpa</i> <sup>11</sup> Aeolidoidea <i>Balcis oldroydæ</i> <i>Barleeia haliotiphila</i> <sup>12</sup> <i>Bulla gouldiana</i> <i>Caecum californicum</i> <i>Caecum crebricinctum</i> <i>Collisella ochracea</i> <i>Crepidatella dorsata</i> <sup>13</sup> <i>Epitonium sawinæ</i> <sup>14</sup> <i>Fissurella volcano</i> <i>Odostomia</i> sp D MBC 1980 <i>Odostomia eugena</i> <i>Odostomia helga</i> <i>Olivella baetica</i> <i>Tegula aureotincta</i> <i>Tegula einseni</i> <i>Turbonilla santarosana</i> <sup>15</sup>	

**Appendix G-1. (Cont.).**

PHYLUM Subphylum or Class Species	PHYLUM Subphylum or Class Species
<b>ANELIDA (Cont.).</b>	<b>ARTHROPODA (Cont.).</b>
Polychaeta	Malacostraca
<i>Paraonidae</i>	<i>Heptacarpus palpator</i>
<i>Parapriionospio pinnata</i>	<i>Hornellia occidentalis</i> <sup>50</sup>
<i>Pectinaria californiensis</i>	<i>Incisocalliope bairdi</i>
<i>Pherusa neopapillata</i>	<i>Jassa slatteryi</i> <sup>51</sup>
<i>Phyllodoce hartmanae</i>	<i>Joeropsis dubia</i>
<i>Phyllodoce</i> sp	<i>Lamprops carinatus</i>
<i>Pista bensei</i>	<i>Lamprops quadruplicatus</i>
<i>Pista disjuncta</i>	<i>Lepidopa californica</i>
<i>Platynereis bicanaliculata</i>	<i>Leptocheilia dubia</i> <sup>52</sup>
<i>Podarkeopsis glabrus</i>	<i>Listriella eriopispa</i>
<i>Polycirrus californicus</i>	<i>Listriella melenica</i>
<i>Polycirrus</i> sp A SCAMIT 1995	<i>Maera similis</i> <sup>53</sup>
<i>Praxillella pacifica</i>	<i>Mayerella banksia</i>
<i>Prionospio (Minuspio) lighti</i> <sup>51</sup>	<i>Munna chromatocephala</i>
<i>Prionospio (Prionospio) heterobranchia</i>	<i>Nebalia hessleri</i>
<i>Protodorvillea gracilis</i>	<i>Neotrypaea californiensis</i> <sup>54</sup>
<i>Pseudopolydora paucibranchiata</i>	<i>Oxyurostylis pacifica</i>
<i>Saccocirrus</i> sp <sup>52</sup>	<i>Paramicrodeutopus schmitti</i>
<i>Scalibregma californicum</i>	<i>Photis bifurcata</i>
<i>Scoletoma</i> sp	<i>Photis brevipes</i>
<i>Scoletoma</i> sp A (Harris 1985)	<i>Photis californica</i>
<i>Scoletoma</i> sp B (Harris 1985)	<i>Photis OC 1 Diener 1992</i>
<i>Scoletoma</i> sp C (Harris 1985)	<i>Pinnixa franciscana</i>
<i>Scoletoma tetrica</i> Cmplx <sup>53</sup>	<i>Podocerus brasiliensis</i>
<i>Scoloplos acmeceps</i>	<i>Podocerus cristatus</i>
<i>Scoloplos armiger</i>	<i>Rhepoxynius menziesi</i> <sup>55</sup>
<i>Sigalion spinosus</i> <sup>34</sup>	<i>Rocinela belliceps</i>
<i>Sphaerosyllis californiensis</i>	<i>Rudilemboides stenopropodus</i> <sup>56</sup>
<i>Spiochaetopterus costarum</i>	<i>Uromunna ubiquita</i> <sup>57</sup>
<i>Spiophanes bombyx</i>	<i>Zeuxo normani</i>
<i>Spiophanes duplex</i> <sup>35</sup>	Ostracoda
<i>Spirorbis</i> sp	<i>Asteropella slatteryi</i>
<i>Syllis (Ehlersia) heterochaeta</i>	<i>Cyprinotus californicus</i>
<i>Syllis (Typosyllis) farallonensis</i> <sup>36</sup>	<i>Leuroleberis sharpei</i>
<i>Tenonia priops</i> <sup>37</sup>	<i>Parasterope hulingsi</i>
Oligochaeta	<i>Postasterope barnesi</i> <sup>58</sup>
Oligochaeta <sup>38</sup>	<i>Rutiderma judayi</i>
	<i>Rutiderma rostratum</i>
	Pycnogoniida
	<i>Ammothaea hilgendorfi</i>
	<i>Anoplodactylus erectus</i>
	<i>Phoxichilidium parvum</i>
<b>ARTHROPODA</b>	<b>ECHINODERMATA</b>
Cirripedia	Astrocoidea
<i>Balanus pacificus</i>	<i>Astropeten armatus</i>
Copepoda	Echinoidea
<i>Clausidium vancouverense</i>	<i>Dendraster excentricus</i>
Harpacticoida	Echinoidea
<i>Poecilostomatoida</i>	<i>Strongylocentrotus purpuratus</i>
Malacostraca	Holothuroidea
<i>Acuminodeutopus heteruruopus</i>	<i>Leptosynapta</i> sp <sup>59</sup>
<i>Alpheus californiensis</i>	Ophiuroidea
<i>Americhelidium rectipalmum</i> <sup>39</sup>	<i>Amphiodes digitata</i>
<i>Amenchelidium shoemakeri</i> <sup>40</sup>	<i>Amphiodes psara</i> <sup>60</sup>
<i>Anchicalurus occidentalis</i>	<i>Amphipholis squamata</i>
<i>Aoroides exilis</i> <sup>41</sup>	Amphiuridae
<i>Aoroides</i> sp <sup>42</sup>	
<i>Aoroides spinosus</i> <sup>43</sup>	
<i>Apolochus barnardi</i> <sup>44</sup>	
<i>Argissa hamatipes</i>	BRACHIOPODA
<i>Caecognathia crenulatifrons</i> <sup>45</sup>	Inarticulata
<i>Campylaspis rubromaculata</i>	<i>Glottidia albida</i>
<i>Campylaspis</i> sp C Myers & Benedict 1974	
<i>Cancer</i> sp	PHORONA
<i>Caprella californica</i>	Phoronida
<i>Caprella mendax</i>	<i>Phoronis</i> sp
<i>Cerapus tubularis</i> Cmplx	Phoronida
<i>Cumella californica</i> <sup>46</sup>	
<i>Diestylopsis tenuis</i>	
<i>Edotia sublittoralis</i> <sup>47</sup>	
<i>Elasmopus bampo</i>	
<i>Erithonius brasiliensis</i>	
Gammaridea	ECTOPROCTA
<i>Gibberosus myersi</i> <sup>48</sup>	Gymnolaemata
<i>Hartmanodes hartmanae</i> <sup>49</sup>	<i>Bowerbankia gracilis</i>
<i>Hemilemprops californicus</i>	
	CHORDATA
	Hemichordata
	<i>Enteropneusta</i> <sup>61</sup>

## Appendix G-1. (Cont.).

The following footnotes indicate names used in previous surveys:

- |   |   |
|---|---|
| 1 <i>Edwardsia</i> sp A of MEC, or <i>E. sipunculoides</i>                  | 32 <i>Saccocirrus</i> sp. A Harris, <i>S. papillocirrus</i>     |
| 2 <i>Pennatulaceae</i>  | 33 <i>Lumbrineris tetrura</i>                                   |
| 3 <i>Platyhelminthes</i> sp D MBC 1979                                      | 34 <i>Thalenesse spinosum</i>                                   |
| 4 <i>Tubularus pellucidus/polymorphus</i> , <i>T.</i> sp. or <i>T.</i> spp. | 35 <i>Spiophanes missionensis</i>                               |
| 5 <i>Paranemertes</i> sp. A of SCAMIT                                       | 36 <i>Typosyllis farallonensis</i>                              |
| 6 <i>Irus lamelleifer</i>   | 37 <i>Harmothoe priops</i>                                      |
| 7 <i>Mysella</i> sp A SCAMIT 1988   | 38 <i>Tubificoides gabriellae</i> or <i>T. apectinatus</i>      |
| 8 <i>Mysella tumida</i>   | 39 <i>Synchelidium rectipalmum</i>                              |
| 9 <i>Tellina carpenteri</i>   | 40 <i>Synchelidium shoemakeri</i>                               |
| 10 <i>Cylichnella culcitella</i>  | 41 <i>Aora exilis</i>   |
| 11 <i>Cylichnella harpa</i>   | 42 <i>Aora</i> sp   |
| 12 <i>Barlecia californica</i>  | 43 <i>Aora spinosa</i>  |
| 13 <i>Crepidula dorsata</i>   | 44 <i>Amphilochus neapolitanus</i>                              |
| 14 <i>Nitidiscala sawiniae</i>  | 45 <i>Gnathia crenulatifrons</i>                                |
| 15 <i>Turbonilla</i> sp E MBC   | 46 <i>Cumella</i> sp. A Myers & Benedict or <i>C.</i> sp. A MBC |
| 16 <i>Golfingia misakiana</i>   | 47 <i>Edotea sublittoralis</i>                                  |
| 17 <i>Aphelocheete</i> sp C of Dorsey, <i>Tharyx</i> sp C of SCAMIT         | 48 <i>Megaluropus longimerus</i>                                |
| 18 <i>Acmina catherinae</i>   | 49 <i>Monoculodes hartmanae</i>                                 |
| 19 <i>Acmina horikoshii</i>   | 50 <i>Metaceradocus occidentalis</i>                            |
| 20 <i>Armandia bioculata</i>  | 51 <i>Jassa falcata</i>   |
| 21 <i>Chaetozone "setosa"</i> , <i>C.</i> cf. <i>setosa</i>                 | 52 <i>Leptochelia</i> spp., <i>L.</i> sp.                       |
| 22 <i>Schistomerings longicornis</i> (in part)                              | 53 <i>Maera simile</i>  |
| 23 <i>Glycera convolute</i>   | 54 <i>Cellianassa</i> sp.                                       |
| 24 <i>Glycera capitata</i>  | 55 <i>Paraphoxus epistomus</i> , <i>Rhepoxynius epistomus</i>   |
| 25 <i>Haploscoloplos elongatus</i>  | 56 <i>Acuminodeutopus stenopropodus</i>                         |
| 26 <i>Mediomastus</i> spp (in part)   | 57 <i>Munna ubiquite</i>  |
| 27 <i>Monticellina dorsobranchialis</i> , <i>Tharyx</i> sp. A SCAMIT        | 58 <i>Parasterope barnesi</i>                                   |
| 28 <i>Nephlys cornuta franciscana</i>                                       | 59 <i>Leptosynapta</i> sp B Benedict                            |
| 29 <i>Notomastus tenuis</i>   | 60 includes <i>Amphiodia occidentalis</i>                       |
| 30 <i>Owenia fusiformis</i>   | 61 Hemichordata   |
| 31 <i>Minuspio cirrifera</i> , <i>Prionospio cirrifera</i>                  |   |

**Appendix G-2. Infauna results by station. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Phylum	Species	Station							Percent	
		B1	B2	B3	B4	B5	B6	B7	Total	Total
AN	<i>Mediomastus ambiseta</i>	101	239	44	1	-	2	3	390	9.84
AN	<i>Oligochaeta</i>	227	17	85	-	-	-	-	329	8.30
AN	<i>Apoprionospio pygmaea</i>	1	8	-	67	25	20	74	195	4.92
AN	<i>Armandia brevis</i>	82	27	41	4	3	-	2	159	4.01
CN	<i>Actiniaria</i>	136	-	4	-	-	-	-	140	3.53
AN	<i>Mediomastus californiensis</i>	19	34	76	-	-	-	-	129	3.26
AN	<i>Notomastus hemipodus</i>	99	15	6	1	1	-	-	122	3.08
MO	<i>Caecum californicum</i>	34	-	78	-	-	-	-	112	2.83
AN	<i>Dorvillea (Schistomerings) annulata</i>	86	5	20	-	-	-	-	111	2.80
AN	<i>Spiophanes bombyx</i>	2	3	3	13	20	25	45	111	2.80
AR	<i>Rhepoxynius menziesi</i>	-	-	-	15	18	15	25	73	1.84
AR	<i>Diastylopsis tenuis</i>	-	-	-	17	13	24	13	67	1.69
AN	<i>Mediomastus acutus</i>	1	1	-	16	11	20	16	65	1.64
AN	<i>Spiophanes duplex</i>	4	12	11	8	3	13	11	62	1.56
NT	<i>Nematoda</i>	31	14	3	5	-	4	-	57	1.44
MO	<i>Caecum crebricinctum</i>	48	-	5	-	-	-	-	53	1.34
AN	<i>Exogone louveri</i>	17	20	13	-	-	2	-	52	1.31
AN	<i>Owenia collaris</i>	1	-	3	7	41	-	-	52	1.31
AN	<i>Syllis (Typosyllis) farallonensis</i>	-	-	-	7	14	17	13	51	1.29
AR	<i>Gibberosus myersi</i>	-	-	-	13	18	11	7	49	1.24
EC	<i>Dendraster excentricus</i>	-	-	-	1	22	8	13	44	1.11
MO	<i>Tellina modesta</i>	-	-	-	4	7	24	9	44	1.11
AN	<i>Chaetozone setosa</i> Cmplx	-	1	3	12	11	6	10	43	1.09
AN	<i>Prionospio (Prionospio) heterobranchia</i>	26	6	10	-	-	-	-	42	1.06
MO	<i>Rochefortia coeni</i>	1	-	1	36	3	-	-	41	1.03
NE	<i>Tubulanus polymorphus</i>	12	9	10	-	6	1	1	39	0.98
AN	<i>Pectinaria californiensis</i>	1	1	-	3	5	1	25	36	0.91
CN	<i>Zaolitus actius</i>	-	-	-	-	29	-	7	36	0.91
AN	<i>Microphthalmus hystrix</i>	34	-	1	-	-	-	-	35	0.88
AN	<i>Scoloplos acmeceps</i>	13	1	21	-	-	-	-	35	0.88
AN	<i>Sphaerosyllis californiensis</i>	16	5	14	-	-	-	-	35	0.88
AR	<i>Photis brevipes</i>	25	-	8	-	-	-	-	33	0.83
MO	<i>Crepidatella dorsata</i>	16	1	14	-	-	-	-	31	0.78
AN	<i>Prionospio (Minusprio) lighti</i>	13	13	4	-	-	-	1	31	0.78
CO	<i>Enteropneusta</i>	3	1	1	5	10	6	4	30	0.76
AN	<i>Monticellina cryptica</i>	1	10	5	2	-	12	-	30	0.76
NE	<i>Lineidae</i>	10	7	7	-	2	2	1	29	0.73
AR	<i>Arooides exilis</i>	22	-	5	-	-	-	-	27	0.68
AN	<i>Megelona sacculata</i>	-	-	-	3	6	2	15	26	0.66
AN	<i>Neptys cornuta</i>	1	21	-	-	2	2	-	26	0.66
AN	<i>Neptys caecoides</i>	-	1	-	5	6	5	6	23	0.58
SI	<i>Apionsoma misakianum</i>	3	-	19	-	-	-	-	22	0.56
EC	<i>Amphiodia digitata</i>	9	3	9	-	-	-	-	21	0.53
AN	<i>Aricidea (Acmira) catherinae</i>	-	1	11	2	4	-	3	21	0.53
AR	<i>Joeropsis dubia</i>	21	-	-	-	-	-	-	21	0.53
AN	<i>Euclymeninae</i> sp A SCAMIT 1987	9	1	10	-	-	-	-	20	0.50
AN	<i>Maldanidae</i>	5	1	14	-	-	-	-	20	0.50
NE	<i>Paranemertes californica</i>	11	3	4	-	-	-	2	20	0.50
MO	<i>Rochefortia tumida</i>	2	-	11	3	1	1	2	20	0.50
NE	<i>Monostylifera</i> sp SD 1 Pt Loma 1995	6	3	9	-	-	1	-	19	0.48
PR	<i>Phoronis</i> sp	2	1	5	1	2	4	3	18	0.45
NE	<i>Cannoma mutabilis</i>	-	-	-	1	7	4	5	17	0.43
AN	<i>Leitoscoloplos pugettensis</i>	-	14	-	-	2	-	1	17	0.43
AR	<i>Maera similis</i>	16	-	-	-	-	-	-	16	0.40
AR	<i>Rudilemboides stenopropodus</i>	10	2	3	-	-	-	-	15	0.38
AN	<i>Micropodarke dubia</i>	9	2	3	-	-	-	-	14	0.35
AN	<i>Goniada littorea</i>	-	-	-	1	5	2	4	12	0.30
AN	<i>Spiochaetopterus costerum</i>	-	-	-	-	3	-	9	12	0.30
EC	<i>Amphipholis squamata</i>	11	-	-	-	-	-	-	11	0.28
AR	<i>Lamprops quadriplicatus</i>	-	-	-	-	8	2	1	11	0.28
AN	<i>Peredoneis lyra</i>	-	-	11	-	-	-	-	11	0.28
AN	<i>Protodorvillea gracilis</i>	-	-	11	-	-	-	-	11	0.28
AN	<i>Sigalion spinosus</i>	-	-	-	-	2	9	-	11	0.28
EC	<i>Strongylocentrotus purpuratus</i>	10	-	1	-	-	-	-	11	0.28
AR	<i>Caprella mendax</i>	1	-	9	-	-	-	-	10	0.25
MO	<i>Cumingia californica</i>	3	1	6	-	-	-	-	10	0.25
AN	<i>Polycirrus californicus</i>	10	-	-	-	-	-	-	10	0.25
AN	<i>Cauleriella aleta</i>	5	-	4	-	-	-	-	9	0.23
AR	<i>Ericthonius brasiliensis</i>	6	1	2	-	-	-	-	9	0.23
AN	<i>Glycera macrobranchia</i>	-	-	-	3	3	-	3	9	0.23
AR	<i>Hartmanodes hartmanae</i>	-	-	-	-	-	1	8	9	0.23
EC	<i>Leptosynapta</i> sp	2	-	6	1	-	-	-	9	0.23
AN	<i>Scoletoma</i> sp C (Harris 1985)	1	6	2	-	-	-	-	9	0.23
AN	<i>Spirorbis</i> sp	8	1	-	-	-	-	-	9	0.23
AN	<i>Malmgreniella macginitieei</i>	2	2	4	-	-	-	-	8	0.20
NE	<i>Nemertea</i>	3	1	-	-	3	1	-	8	0.20

Appendix G-2. (Cont.).

Phylum	Species	Station							Percent	
		B1	B2	B3	B4	B5	B6	B7	Total	Total
MO	<i>Acteocina harpa</i>	3	-	-	-	-	3	1	7	0.18
AR	<i>Americhelidium shoemakeri</i>	-	-	-	1	-	5	1	7	0.18
AR	<i>Jassa slatteryi</i>	4	-	2	-	1	-	-	7	0.18
MO	<i>Macoma</i> sp	-	1	-	1	2	1	2	7	0.18
AR	<i>Zeuxo normani</i>	6	1	-	-	-	-	-	7	0.18
AN	<i>Autolytinae</i>	-	-	-	-	1	3	2	6	0.15
AN	<i>Glycera americana</i>	-	2	4	-	-	-	-	6	0.15
AN	<i>Lumbrineris japonica</i>	2	2	2	-	-	-	-	6	0.15
AN	<i>Nereis procera</i>	2	1	3	-	-	-	-	6	0.15
AN	<i>Scoletoma</i> sp	5	-	-	-	-	-	1	6	0.15
AN	<i>Syllis (Ehlersia) heterochaeta</i>	4	-	1	-	-	-	1	6	0.15
AR	<i>Acuminodeutopus heteruropus</i>	-	5	-	-	-	-	-	5	0.13
AR	<i>Caprella californica</i>	-	-	4	1	-	-	-	5	0.13
MO	<i>Macoma yoldiformis</i>	-	3	-	-	-	2	-	5	0.13
AN	<i>Phyllocoete hartmanae</i>	2	-	-	-	-	-	3	5	0.13
PL	<i>Stylochoplane</i> sp	1	1	3	-	-	-	-	5	0.13
AN	<i>Dispia uncinata</i>	-	-	-	-	1	-	3	4	0.10
AN	<i>Eumida longicornuta</i>	2	-	2	-	-	-	-	4	0.10
AR	<i>Listriella melanica</i>	2	2	-	-	-	-	-	4	0.10
AN	<i>Magelona pitekai</i>	-	-	-	-	-	-	4	4	0.10
MO	<i>Mysella</i> sp H SCAMIT 2001	-	-	4	-	-	-	-	4	0.10
AN	<i>Paleanotus bellis</i>	3	-	1	-	-	-	-	4	0.10
PR	<i>Phoronida</i>	2	2	-	-	-	-	-	4	0.10
AN	<i>Pista bansei</i>	-	-	4	-	-	-	-	4	0.10
AN	<i>Praxillella pacifica</i>	-	3	1	-	-	-	-	4	0.10
AN	<i>Pseudopolydore paucibranchiata</i>	-	4	-	-	-	-	-	4	0.10
MO	<i>Saxidomus nuttalli</i>	3	-	1	-	-	-	-	4	0.10
MO	<i>Tegula aureoincta</i>	4	-	-	-	-	-	-	4	0.10
MO	<i>Aeolidoida</i>	3	-	-	-	-	-	-	3	0.08
EC	<i>Amphiodia psara</i>	-	3	-	-	-	-	-	3	0.08
AR	<i>Asteropella slatteryi</i>	2	1	-	-	-	-	-	3	0.08
AR	<i>Caecognathia crenulatifrons</i>	-	3	-	-	-	-	-	3	0.08
AN	<i>Chone minuta</i>	2	-	1	-	-	-	-	3	0.08
AR	<i>Ediotia sublittoralis</i>	-	-	-	-	1	2	-	3	0.08
BC	<i>Glottidia albida</i>	-	-	3	-	-	-	-	3	0.08
AN	<i>Glycinde armigera</i>	-	-	1	-	2	-	-	3	0.08
AR	<i>Hemilamprops californicus</i>	-	-	-	1	1	1	-	3	0.08
NE	<i>Hoploneuertea</i> sp B MEC 1988	2	-	-	-	-	1	-	3	0.08
AN	<i>Melinna oculata</i>	-	-	3	-	-	-	-	3	0.08
MO	<i>Odostomia eugena</i>	3	-	-	-	-	-	-	3	0.08
AR	<i>Oxyurostylis pacifica</i>	1	1	1	-	-	-	-	3	0.08
AR	<i>Photis</i> OC 1 Diener 1992	-	-	-	-	-	-	3	3	0.08
AR	<i>Phoxichilidium parvum</i>	2	-	1	-	-	-	-	3	0.08
AN	<i>Platynereis bicanaliculata</i>	1	-	2	-	-	-	-	3	0.08
AN	<i>Podarceopsis gibrosus</i>	2	-	-	-	-	-	1	3	0.08
AR	<i>Poecilostomatoidea</i>	-	3	-	-	-	-	-	3	0.08
AN	<i>Polycirrus</i> sp A SCAMIT 1995	3	-	-	-	-	-	-	3	0.08
MO	<i>Protothaca staminea</i>	3	-	-	-	-	-	-	3	0.08
AN	<i>Scoletoma</i> sp B (Harris 1985)	-	3	-	-	-	-	-	3	0.08
AN	<i>Scoloplos armiger</i>	-	-	-	1	1	1	1	3	0.08
AN	<i>Tenoria priops</i>	-	1	-	-	-	2	1	3	0.08
AR	<i>Uromunna ubiquita</i>	-	-	-	-	-	-	-	3	0.08
NE	<i>Zygonemertes virescens</i>	2	-	1	-	-	-	-	3	0.08
MO	<i>Acteocina culicella</i>	-	-	-	-	-	2	-	2	0.05
AR	<i>Americhelidium rectipalmum</i>	-	1	1	-	-	-	-	2	0.05
NE	<i>Amphiporus imperispinosus</i>	-	2	-	-	-	-	-	2	0.05
EC	<i>Amphiuridae</i>	1	-	1	-	-	-	-	2	0.05
AR	<i>Anchicolarus occidentalis</i>	-	-	-	-	2	-	-	2	0.05
AR	<i>Arooides</i> sp	-	-	-	-	-	-	2	2	0.05
AN	<i>Aphelochaeta glandaria</i>	-	1	1	-	-	-	-	2	0.05
AR	<i>Apolochus barnardi</i>	2	-	-	-	-	-	-	2	0.05
AR	<i>Balanus pacificus</i>	2	-	-	-	-	-	-	2	0.05
MO	<i>Barlecia haliotiphila</i>	2	-	-	-	-	-	-	2	0.05
MO	<i>Bivalvia</i>	-	1	1	-	-	-	-	2	0.05
AR	<i>Campyleaspis</i> sp C Myers & Benedict 1974	-	-	-	-	2	-	-	2	0.05
AN	<i>Capitella capitata</i> Cmpx	2	-	-	-	-	-	-	2	0.05
AN	<i>Chone mollis</i>	-	-	-	-	1	1	-	2	0.05
AN	<i>Chone</i> sp SD 1 Pt. Loma 1997	-	-	-	-	-	1	1	2	0.05
MO	<i>Collisella ochracea</i>	1	-	1	-	-	-	-	2	0.05
MO	<i>Cooperella subdiaphana</i>	-	-	-	-	-	-	2	2	0.05
AR	<i>Cumella californica</i>	-	-	-	-	-	-	-	2	0.05
AR	<i>Cyprinotus californicus</i>	2	-	-	-	-	-	-	2	0.05
CN	<i>Edwardsia</i> sp G MEC 1992	-	-	2	-	-	-	-	2	0.05
AR	<i>Elasmopuspampino</i>	-	1	1	-	-	-	-	2	0.05
AR	<i>Harpacticoida</i>	2	-	-	-	-	-	-	2	0.05
AR	<i>Hornellia occidentalis</i>	2	-	-	-	-	-	-	2	0.05
AN	<i>Hydroides gracilis</i>	2	-	-	-	-	-	-	2	0.05
MO	<i>Laevicardium substratum</i>	1	1	-	-	-	-	-	2	0.05

Appendix G-2. (Cont.).

Phylum Species	Station							Percent	
	B1	B2	B3	B4	B5	B6	B7	Total	Total
MO <i>Leporimetis obesa</i>	-	-	2	-	-	-	-	2	0.05
AR <i>Leuroleberis sharpei</i>	1	-	-	-	-	1	-	2	0.05
MO <i>Lithophaga plumula</i>	2	-	-	-	-	-	-	2	0.05
AN <i>Malmgreniella</i> sp A SCAMIT 1997	1	-	1	-	-	-	-	2	0.05
AN <i>Naineris dendritica</i>	2	-	-	-	-	-	-	2	0.05
AN <i>Neosabellaria cementarium</i>	1	-	1	-	-	-	-	2	0.05
AR <i>Neotrypaea californiensis</i>	-	-	-	-	-	-	2	2	0.05
MO <i>Odostomia helga</i>	2	-	-	-	-	-	-	2	0.05
CN <i>Pennatulacea</i>	-	-	-	1	-	-	1	2	0.05
AR <i>Photis bifurcata</i>	1	1	-	-	-	-	-	2	0.05
AR <i>Pinnixa franciscana</i>	1	1	-	-	-	-	-	2	0.05
AN <i>Pista disjuncta</i>	2	-	-	-	-	-	-	2	0.05
AR <i>Postasterope barnesi</i>	2	-	-	-	-	-	-	2	0.05
AR <i>Rutiderma judayi</i>	1	-	1	-	-	-	-	2	0.05
MO <i>Siliqua lucida</i>	-	-	-	-	-	-	2	2	0.05
SI <i>Sipuncula</i>	-	2	-	-	-	-	-	2	0.05
MO <i>Tegula eiseni</i>	2	-	-	-	-	-	-	2	0.05
NE <i>Tetrastremma</i> sp A SCAMIT 1995	1	-	1	-	-	-	-	2	0.05
NE <i>Tubulanus nothus</i>	1	-	1	-	-	-	-	2	0.05
MO <i>Turbanilla santarosana</i>	-	-	-	-	1	-	1	2	0.05
MO <i>Turbanilla</i> sp F MBC 1971	2	-	-	-	-	-	-	2	0.05
AR <i>Alpheus californiensis</i>	-	1	-	-	-	-	-	1	0.03
AN <i>Amaeana occidentalis</i>	-	-	-	1	-	-	-	1	0.03
AR <i>Ammothea hilgendorfi</i>	1	-	-	-	-	-	-	1	0.03
AN <i>Ampharete labrops</i>	-	1	-	-	-	-	-	1	0.03
AR <i>Anoplodactylus erectus</i>	1	-	-	-	-	-	-	1	0.03
AR <i>Arooides spinosus</i>	-	1	-	-	-	-	-	1	0.03
AR <i>Argissa hamatipes</i>	-	-	-	-	-	1	-	1	0.03
AN <i>Aricidea (Acmina) horikoshii</i>	-	-	-	-	1	-	-	1	0.03
EC <i>Astropecten armatus</i>	-	-	-	1	-	-	-	1	0.03
MO <i>Balcis oldroydae</i>	-	-	-	-	1	-	-	1	0.03
EP <i>Bowerbankia gracilis</i>	-	-	1	-	-	-	-	1	0.03
MO <i>Bulla gouldiana</i>	1	-	-	-	-	-	-	1	0.03
AR <i>Campylaspis rubromaculata</i>	-	-	1	-	-	-	-	1	0.03
AR <i>Cancer</i> sp	1	-	-	-	-	-	-	1	0.03
AR <i>Cerapus tubularis</i> Cmplx	-	-	-	-	-	1	-	1	0.03
AN <i>Cheatozone columbiana</i>	-	-	1	-	-	-	-	1	0.03
AN <i>Cirratulidae</i>	1	-	-	-	-	-	-	1	0.03
AN <i>Cirratulus cirratus</i>	1	-	-	-	-	-	-	1	0.03
AR <i>Cleidium vancouverense</i>	-	-	1	-	-	-	-	1	0.03
AN <i>Cossure</i> sp A Phillips 1987	-	1	-	-	-	-	-	1	0.03
AN <i>Diopatra ornata</i>	1	-	-	-	-	-	-	1	0.03
EC <i>Echinoidea</i>	-	1	-	-	-	-	-	1	0.03
EH <i>Echiura</i>	-	-	-	-	1	-	-	1	0.03
MO <i>Ennucula tenuis</i>	-	-	-	-	-	1	-	1	0.03
MO <i>Epitonium sawinae</i>	1	-	-	-	-	-	-	1	0.03
AN <i>Eteone californica</i>	-	-	-	-	-	1	-	1	0.03
MO <i>Fissurella volcano</i>	1	-	-	-	-	-	-	1	0.03
AR <i>Gammaridea</i>	-	1	-	-	-	-	-	1	0.03
AN <i>Glycera nana</i>	-	-	1	-	-	-	-	1	0.03
AN <i>Halosydna johnsoni</i>	-	-	1	-	-	-	-	1	0.03
AN <i>Halosydna brevisetosa</i>	-	-	-	1	-	-	-	1	0.03
AR <i>Heptacarpus palpator</i>	-	-	1	-	-	-	-	1	0.03
AN <i>Hesionella mccullochae</i>	1	-	-	-	-	-	-	1	0.03
AR <i>Incisocalliope bairdi</i>	-	-	-	-	-	1	-	1	0.03
MO <i>Irusella lamellifera</i>	1	-	-	-	-	-	-	1	0.03
MO <i>Kellia suborbicularis</i>	1	-	-	-	-	-	-	1	0.03
AR <i>Lamprops cerinatus</i>	-	-	1	-	-	-	-	1	0.03
AN <i>Laonice cirrata</i>	1	-	-	-	-	-	-	1	0.03
AR <i>Lepidopa californica</i>	-	-	-	-	1	-	-	1	0.03
AR <i>Leptocheilia dubia</i>	1	-	-	-	-	-	-	1	0.03
PL <i>Leptoplaniidae</i> sp A MEC 1988	-	-	1	-	-	-	-	1	0.03
AR <i>Listriella eriopisae</i>	-	1	-	-	-	-	-	1	0.03
AN <i>Lysippe</i> sp A Williams 1985	-	1	-	-	-	-	-	1	0.03
AR <i>Mayerella banksiae</i>	1	-	-	-	-	-	-	1	0.03
AN <i>Megalomima pigmentum</i>	-	1	-	-	-	-	-	1	0.03
AR <i>Munna chromatocephala</i>	1	-	-	-	-	-	-	1	0.03
MO <i>Mytilidae</i>	1	-	-	-	-	-	-	1	0.03
AR <i>Nebalia hessleri</i>	1	-	-	-	-	-	-	1	0.03
AN <i>Notomastus</i> sp A SCAMIT 2001	1	-	-	-	-	-	-	1	0.03
AN <i>Odontosyllis phosphorea</i>	1	-	-	-	-	-	-	1	0.03
MO <i>Odostomia</i> sp D MBC 1980	1	-	-	-	-	-	-	1	0.03
MO <i>Olivella baetica</i>	-	-	-	-	-	-	1	1	0.03
AN <i>Onuphidae</i>	-	-	-	-	1	-	-	1	0.03
AN <i>Onuphis</i> sp 1 Pt. Loma 1983	-	-	-	-	-	-	1	1	0.03
AN <i>Ophiodromus pugettensis</i>	1	-	-	-	-	-	-	1	0.03
AR <i>Paramicromedusopus schmitti</i>	1	-	-	-	-	-	-	1	0.03
AN <i>Paraonidae</i>	1	-	-	-	-	-	-	1	0.03

**Appendix G-2. (Cont.).**

Phylum Species	Station							Percent	
	B1	B2	B3	B4	B5	B6	B7	Total	Total
AN <i>Parapriionospio pinnata</i>	-	1	-	-	-	-	-	1	0.03
AR <i>Parasterope hulingsi</i>	-	-	1	-	-	-	-	1	0.03
MO <i>Periploma planiusculum</i>	-	-	-	-	-	1	-	1	0.03
MO <i>Petricola</i> sp	1	-	-	-	-	-	-	1	0.03
AN <i>Pherusa neopapillata</i>	-	-	1	-	-	-	-	1	0.03
AR <i>Photis californica</i>	-	1	-	-	-	-	-	1	0.03
AN <i>Phyllodoce</i> sp	-	-	1	-	-	-	-	1	0.03
AR <i>Podocerus brasiliensis</i>	1	-	-	-	-	-	-	1	0.03
AR <i>Podocerus cristatus</i>	-	-	1	-	-	-	-	1	0.03
AR <i>Rocinela belliceps</i>	1	-	-	-	-	-	-	1	0.03
AR <i>Rutiderma rostratum</i>	1	-	-	-	-	-	-	1	0.03
AN <i>Saccocirrus</i> sp	-	-	1	-	-	-	-	1	0.03
AN <i>Scalibregma californicum</i>	1	-	-	-	-	-	-	1	0.03
CN <i>Scolanthus</i> sp A SCAMIT 1983	-	1	-	-	-	-	-	1	0.03
AN <i>Scoletoma</i> sp A (Harris 1985)	-	1	-	-	-	-	-	1	0.03
AN <i>Scoletoma tetraura</i> Cmplx	-	-	-	1	-	-	-	1	0.03
MO <i>Solen sicarius</i>	-	-	-	-	1	-	-	1	0.03
MO <i>Tagelus subteres</i>	-	-	1	-	-	-	-	1	0.03
MO <i>Tellina</i> sp B SCAMIT 2001	-	1	-	-	-	-	-	1	0.03
MO <i>Thracia trapezoides</i>	1	-	-	-	-	-	-	1	0.03
Number of individuals	1391	582	726	268	343	276	377	3963	
Number of species	139	83	99	40	55	50	52	252	
Diversity (H')	3.57	2.87	3.64	2.85	3.39	3.30	3.17	4.22	

**Appendix G-3. Infaunal data by station and replicate. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

**Station B1**

Phylum Species	Replicate				Total	Percent Composition	Density No./m <sup>2</sup>
	B1-I	B1-II	B1-III	B1-IV			
AN Oligochaeta	33	47	68	79	227	16.32	567.5
CN Actinaria	9	39	39	49	136	9.78	340.0
AN <i>Mediomastus ambiseta</i>	34	20	37	10	101	7.26	252.5
AN <i>Notornastus hemipodus</i>	6	36	41	16	99	7.12	247.5
AN <i>Dorvillea (Schistomerings) annulata</i>	1	13	16	56	86	6.18	215.0
AN <i>Armandia brevis</i>	15	32	23	12	82	5.90	205.0
MO <i>Caecum crebricinctum</i>	8	10	27	3	48	3.45	120.0
MO <i>Caecum californicum</i>	1	17	14	2	34	2.44	85.0
AN <i>Microphthalmus hystrix</i>	-	8	13	13	34	2.44	85.0
NT Nematoda	-	3	12	16	31	2.23	77.5
AN <i>Prionospio (Prionospio) heterobranchia</i>	5	5	10	6	26	1.87	65.0
AR <i>Photis brevipes</i>	1	10	12	2	25	1.80	62.5
AR <i>Aoroides exilis</i>	1	7	13	1	22	1.58	55.0
AR <i>Joeropsis dubia</i>	-	13	8	-	21	1.51	52.5
AN <i>Mediomastus californiensis</i>	3	8	8	-	19	1.37	47.5
AN <i>Exogone lourei</i>	5	7	3	2	17	1.22	42.5
MO <i>Crepipatella dorsata</i>	1	2	5	8	16	1.15	40.0
AR <i>Maera similis</i>	-	8	8	-	16	1.15	40.0
AN <i>Sphaerosyllis californiensis</i>	6	7	3	-	16	1.15	40.0
AN <i>Prionospio (Minusprio) lighti</i>	2	5	3	3	13	0.93	32.5
AN <i>Scoloplos acmeceps</i>	1	2	4	6	13	0.93	32.5
NE <i>Tubulanus polymorphus</i>	3	4	3	2	12	0.86	30.0
EC <i>Amphipholis squemata</i>	-	5	5	1	11	0.79	27.5
NE <i>Paranemertes californica</i>	2	5	2	2	11	0.79	27.5
NE <i>Lineidae</i>	3	-	4	3	10	0.72	25.0
AN <i>Polycirrus californicus</i>	-	5	3	2	10	0.72	25.0
AR <i>Rudilemboides stenopropodus</i>	2	-	4	4	10	0.72	25.0
EC <i>Strongylocentrotus purpuratus</i>	1	2	6	1	10	0.72	25.0
EC <i>Amphiodia digitata</i>	-	7	1	1	9	0.65	22.5
AN <i>Euclymeninae</i> sp A SCAMIT 1987	-	2	6	1	9	0.65	22.5
AN <i>Micropodarke dubia</i>	1	2	4	2	9	0.65	22.5
AN <i>Spirorbis</i> sp	-	-	4	4	8	0.58	20.0
AR <i>Erictionius brasiliensis</i>	2	-	1	3	6	0.43	15.0
NE <i>Monostylifera</i> sp SD 1 Pt Loma 1995	-	5	1	-	6	0.43	15.0
AR <i>Zeuxo normani</i>	-	1	5	-	6	0.43	15.0
AN <i>Caulieriella alata</i>	-	1	1	3	5	0.36	12.5
AN <i>Maldanidae</i>	1	2	2	-	5	0.36	12.5
AN <i>Scoletoma</i> sp	-	2	2	1	5	0.36	12.5
AR <i>Jessa slatteryi</i>	-	1	3	-	4	0.29	10.0
AN <i>Spiophanes duplex</i>	2	-	-	2	4	0.29	10.0
AN <i>Syllis (Ehlersia) heterochaeta</i>	1	2	1	-	4	0.29	10.0
MO <i>Tegula aureotincta</i>	-	-	4	-	4	0.29	10.0
MO <i>Acteocina harpa</i>	-	3	-	-	3	0.22	7.5
MO <i>Aeolidioida</i>	-	2	1	-	3	0.22	7.5
SI <i>Apionsoma misakianum</i>	-	2	-	1	3	0.22	7.5
MO <i>Cumingia californica</i>	1	-	-	2	3	0.22	7.5
CO <i>Enteropneusta</i>	2	1	-	-	3	0.22	7.5
NE <i>Nemertea</i>	-	1	1	1	3	0.22	7.5
MO <i>Odostomia eugena</i>	-	-	3	-	3	0.22	7.5
AN <i>Paleanotus bellis</i>	-	3	-	-	3	0.22	7.5
AN <i>Polycirrus</i> sp A SCAMIT 1995	-	-	2	1	3	0.22	7.5
MO <i>Protobrachia staminea</i>	-	-	2	1	3	0.22	7.5
MO <i>Saxidomus nuttallii</i>	-	-	1	2	3	0.22	7.5
AR <i>Apolochus barnardi</i>	-	2	-	-	2	0.14	5.0
AR <i>Asteropella slatteryi</i>	1	-	1	-	2	0.14	5.0
AR <i>Balanus pacificus</i>	1	-	1	-	2	0.14	5.0
MO <i>Barlecia haliotiphila</i>	2	-	-	-	2	0.14	5.0
AN <i>Capitella capitata</i> Cmplx	-	-	-	2	2	0.14	5.0
AN <i>Chone minuta</i>	-	-	-	2	2	0.14	5.0
AR <i>Cyprinotus californicus</i>	1	-	-	1	2	0.14	5.0
AN <i>Eumida longicornuta</i>	1	-	1	-	2	0.14	5.0
AR <i>Harpacticoida</i>	-	2	-	-	2	0.14	5.0
NE <i>Hoplonemertea</i> sp B MEC 1988	1	1	-	-	2	0.14	5.0
AR <i>Hornellia occidentalis</i>	1	-	1	-	2	0.14	5.0
AN <i>Hydroides gracilis</i>	-	-	-	2	2	0.14	5.0

**Appendix G-3. (Cont.).**

**Station B1**

Phylum Species	Replicate				Total	Percent Composition	Density No./m <sup>2</sup>
	B1-I	B1-II	B1-III	B1-IV			
EC <i>Leptosynapta</i> sp	1	-	1	-	2	0.14	5.0
AR <i>Listriella melanica</i>	-	-	2	-	2	0.14	5.0
MO <i>Lithophaga plumula</i>	-	1	1	-	2	0.14	5.0
AN <i>Lumbrineris japonica</i>	-	1	1	-	2	0.14	5.0
AN <i>Malmgreniella macginitieei</i>	1	-	1	-	2	0.14	5.0
AN <i>Naineris dendritica</i>	-	1	-	1	2	0.14	5.0
AN <i>Nereis procta</i>	1	1	-	-	2	0.14	5.0
MO <i>Odostomia helga</i>	-	-	1	1	2	0.14	5.0
PR <i>Phoronida</i>	-	1	-	1	2	0.14	5.0
PR <i>Phoronis</i> sp	-	1	-	1	2	0.14	5.0
AR <i>Phoxichilidium parvum</i>	-	-	1	1	2	0.14	5.0
AN <i>Phyllocoete hartmanae</i>	1	-	1	-	2	0.14	5.0
AN <i>Pista disjuncta</i>	-	2	-	-	2	0.14	5.0
AN <i>Podarkeopsis glabrus</i>	-	2	-	-	2	0.14	5.0
AR <i>Postasterope barnesi</i>	1	-	1	-	2	0.14	5.0
MO <i>Rochefortia tumida</i>	1	-	1	-	2	0.14	5.0
AN <i>Spiophanes bombyx</i>	-	-	2	-	2	0.14	5.0
MO <i>Tegula einensi</i>	-	-	2	-	2	0.14	5.0
MO <i>Turbanilla</i> sp F MBC 1971	1	-	1	-	2	0.14	5.0
NE <i>Zygonemertes virescens</i>	-	2	-	-	2	0.14	5.0
AR <i>Ammothea hilgendorfi</i>	-	1	-	-	1	0.07	2.5
EC <i>Amphiuridae</i>	-	1	-	-	1	0.07	2.5
AR <i>Anoplodactylus erectus</i>	-	1	-	-	1	0.07	2.5
AN <i>Apoprianospio pygmaea</i>	-	1	-	-	1	0.07	2.5
MO <i>Bulla gouldiana</i>	-	1	-	-	1	0.07	2.5
AR <i>Cancer</i> sp	-	1	-	-	1	0.07	2.5
AR <i>Caprella mendax</i>	-	-	-	1	1	0.07	2.5
AN <i>Cirratulidae</i>	-	1	-	-	1	0.07	2.5
AN <i>Cirratulus cirratus</i>	-	1	-	-	1	0.07	2.5
MO <i>Collisella ochracea</i>	-	1	-	-	1	0.07	2.5
AR <i>Cumella californica</i>	-	-	1	-	1	0.07	2.5
AN <i>Diopatra ornata</i>	1	-	-	-	1	0.07	2.5
MO <i>Epitonium sawiniae</i>	-	1	-	-	1	0.07	2.5
MO <i>Fissurella volcano</i>	-	-	-	1	1	0.07	2.5
AN <i>Hesionella mccullochae</i>	-	-	1	-	1	0.07	2.5
MO <i>Irusella lamellifera</i>	1	-	-	-	1	0.07	2.5
MO <i>Kellia suborbicularis</i>	-	-	1	-	1	0.07	2.5
MO <i>Laevicardium substratum</i>	-	1	-	-	1	0.07	2.5
AN <i>Laonice cirrata</i>	-	1	-	-	1	0.07	2.5
AR <i>Leptochelia dubia</i>	-	-	1	-	1	0.07	2.5
AR <i>Leuroleberis sharpei</i>	-	-	1	-	1	0.07	2.5
AN <i>Malmgreniella</i> sp A SCAMIT 1997	-	-	1	-	1	0.07	2.5
AR <i>Mayerella banksia</i>	-	-	-	1	1	0.07	2.5
AN <i>Mediomastus acutus</i>	-	-	-	1	1	0.07	2.5
AN <i>Monticellina cryptica</i>	1	-	-	-	1	0.07	2.5
AR <i>Munna chromatocephala</i>	-	1	-	-	1	0.07	2.5
MO <i>Mytilidae</i>	-	-	1	-	1	0.07	2.5
AR <i>Nebalia hessleri</i>	1	-	-	-	1	0.07	2.5
AN <i>Neosabellaria cementarium</i>	-	-	-	1	1	0.07	2.5
AN <i>Nephtys cornuta</i>	-	1	-	-	1	0.07	2.5
AN <i>Notomastus</i> sp A SCAMIT 2001	1	-	-	-	1	0.07	2.5
AN <i>Odontosyllis phosphorea</i>	-	1	-	-	1	0.07	2.5
MO <i>Odostomia</i> sp D MBC 1980	-	1	-	-	1	0.07	2.5
AN <i>Ophiodromus pugettensis</i>	-	1	-	-	1	0.07	2.5
AN <i>Owenia collaris</i>	-	-	1	-	1	0.07	2.5
AR <i>Oxyurostylis pacifica</i>	-	-	-	1	1	0.07	2.5
AR <i>Paramicrodeutopus schmitti</i>	-	1	-	-	1	0.07	2.5
AN <i>Paraoenidae</i>	1	-	-	-	1	0.07	2.5
AN <i>Pectinaria californiensis</i>	-	-	-	1	1	0.07	2.5
MO <i>Petricola</i> sp	-	-	1	-	1	0.07	2.5
AR <i>Photis bifurcate</i>	-	1	-	-	1	0.07	2.5
AR <i>Pinnixa franciscana</i>	-	-	1	-	1	0.07	2.5
AN <i>Platynereis bicanaliculata</i>	-	1	-	-	1	0.07	2.5
AR <i>Podocerus brasiliensis</i>	-	1	-	-	1	0.07	2.5
MO <i>Rochefortia coeni</i>	-	-	1	-	1	0.07	2.5

**Appendix G-3. (Cont.).**

**Station B1**

Phylum Species	Replicate				Total	Percent Composition	Density No./m <sup>2</sup>
	B1-I	B1-II	B1-III	B1-IV			
AR <i>Rocinela beliceps</i>	1	-	-	-	1	0.07	2.5
AR <i>Rutiderma judayi</i>	-	1	-	-	1	0.07	2.5
AR <i>Rutiderma rostratum</i>	-	1	-	-	1	0.07	2.5
AN <i>Scalibregma californicum</i>	-	1	-	-	1	0.07	2.5
AN <i>Scoletoma</i> sp C (Harris 1985)	1	-	-	-	1	0.07	2.5
PL <i>Stylochoplana</i> sp	-	-	-	1	1	0.07	2.5
NE <i>Tetrastemma</i> sp A SCAMIT 1995	-	-	1	-	1	0.07	2.5
MO <i>Thracia trapezoides</i>	-	1	-	-	1	0.07	2.5
NE <i>Tubulanus nothus</i>	-	-	-	1	1	0.07	2.5

**Summary**

Parameter	Replicate				Station	Replicate		
	B1-I	B1-II	B1-III	B1-IV		Total	Mean	S.D.
Number of individuals	176	399	471	345	1391	347.8	125.6	
Number of species	51	79	76	56	139	65.5	14.1	
Diversity (H')	3.07	3.55	3.46	2.89	3.57	3.24	0.31	

Appendix G-3. (Cont.).

Station B2

Phylum Species	Replicate				Total	Percent Composition	Density No./m <sup>2</sup>
	B2-I	B2-II	B2-III	B2-IV			
AN <i>Mediomastus ambiseta</i>	67	74	19	79	239	41.07	597.5
AN <i>Mediomastus californiensis</i>	11	11	3	9	34	5.84	85.0
AN <i>Armandia brevis</i>	6	6	-	15	27	4.64	67.5
AN <i>Nephtys cornuta</i>	5	-	4	12	21	3.61	52.5
AN <i>Exogone lourei</i>	6	7	2	5	20	3.44	50.0
AN <i>Oligochaeta</i>	4	4	2	7	17	2.92	42.5
AN <i>Notomastus hemipodus</i>	4	8	2	1	15	2.58	37.5
AN <i>Leitoscoloplos pugettensis</i>	2	1	3	8	14	2.41	35.0
NT <i>Nematoda</i>	2	7	1	4	14	2.41	35.0
AN <i>Prionospio (Minuspio) lighti</i>	2	3	3	5	13	2.23	32.5
AN <i>Spiophanes duplex</i>	5	3	2	2	12	2.06	30.0
AN <i>Monticellina cryptica</i>	3	2	1	4	10	1.72	25.0
NE <i>Tubulanus polymorphus</i>	2	3	2	2	9	1.55	22.5
AN <i>Apopriopriospio pygmaea</i>	3	2	2	1	8	1.37	20.0
NE <i>Lineidae</i>	4	-	2	1	7	1.20	17.5
AN <i>Prionospio (Prionospio) heterobranchia</i>	1	1	-	4	6	1.03	15.0
AN <i>Scoletoma</i> sp C (Harris 1985)	1	5	-	-	6	1.03	15.0
AR <i>Acuminodeutopus heteruropus</i>	1	-	1	3	5	0.86	12.5
AN <i>Dorvillea (Schistomerings) annulata</i>	1	-	4	-	5	0.86	12.5
AN <i>Sphaerosyllis californiensis</i>	2	3	-	-	5	0.86	12.5
AN <i>Pseudopolydora paucibranchiate</i>	1	2	1	-	4	0.69	10.0
EC <i>Amphiodia digitata</i>	-	-	2	1	3	0.52	7.5
EC <i>Amphiodia psara</i>	1	1	1	-	3	0.52	7.5
AR <i>Caecognathis crenulatifrons</i>	-	-	3	-	3	0.52	7.5
MO <i>Macoma yoldiformis</i>	2	-	-	1	3	0.52	7.5
NE <i>Monostylifera</i> sp SD 1 Pt Loma 1995	-	-	2	1	3	0.52	7.5
NE <i>Paranemertes californica</i>	1	-	1	1	3	0.52	7.5
AR <i>Poecilostomatoidea</i>	2	1	-	-	3	0.52	7.5
AN <i>Praxillella pacifica</i>	2	-	1	-	3	0.52	7.5
AN <i>Scoletoma</i> sp B (Harris 1985)	-	-	-	3	3	0.52	7.5
AN <i>Spiophanes bombyx</i>	2	-	-	1	3	0.52	7.5
NE <i>Amphiporus imparispinosus</i>	-	-	2	-	2	0.34	5.0
AN <i>Glycera americana</i>	2	-	-	-	2	0.34	5.0
AR <i>Listriella melanica</i>	-	2	-	-	2	0.34	5.0
AN <i>Lumbrineris japonica</i>	-	1	1	-	2	0.34	5.0
AN <i>Malmgreniella macginittiei</i>	1	-	-	1	2	0.34	5.0
AN <i>Micropodarke dubia</i>	-	-	-	2	2	0.34	5.0
PR <i>Phoronida</i>	2	-	-	-	2	0.34	5.0
AR <i>Rudilemboides stenopropodus</i>	-	-	-	2	2	0.34	5.0
SI <i>Sipuncula</i>	-	1	1	-	2	0.34	5.0
AR <i>Alpheus californiensis</i>	-	-	-	1	1	0.17	2.5
AR <i>Americhelidium rectipalmum</i>	-	-	-	1	1	0.17	2.5
AN <i>Ampharete labrops</i>	-	-	1	-	1	0.17	2.5
AR <i>Aoroides spinosus</i>	-	1	-	-	1	0.17	2.5
AN <i>Aphelochaeta glandaria</i>	-	-	1	-	1	0.17	2.5
AN <i>Aricidea (Acmina) catherinae</i>	-	1	-	-	1	0.17	2.5
AR <i>Asteropella slatteryi</i>	-	-	-	1	1	0.17	2.5
MO <i>Bivalvia</i>	-	-	-	1	1	0.17	2.5
AN <i>Chaetozone setosa</i> Cmplx	1	-	-	-	1	0.17	2.5
AN <i>Cossura</i> sp A Phillips 1987	-	-	-	1	1	0.17	2.5
MO <i>Crepidatella dorsata</i>	-	1	-	-	1	0.17	2.5
MO <i>Cumingia californica</i>	1	-	-	-	1	0.17	2.5
EC <i>Echinoidea</i>	-	1	-	-	1	0.17	2.5
AR <i>Elasmopus bampo</i>	-	1	-	-	1	0.17	2.5
CO <i>Enteropneusta</i>	1	-	-	-	1	0.17	2.5
AR <i>Ericthonius brasiliensis</i>	-	1	-	-	1	0.17	2.5
AN <i>Euclymeninae</i> sp A SCAMIT 1987	-	-	1	-	1	0.17	2.5
AR <i>Gammaridea</i>	-	-	-	1	1	0.17	2.5
MO <i>Laevicardium substratum</i>	-	-	-	1	1	0.17	2.5
AR <i>Listriella eropisa</i>	-	-	1	-	1	0.17	2.5
AN <i>Lysippe</i> sp A Williams 1985	1	-	-	-	1	0.17	2.5
MO <i>Macoma</i> sp	-	-	-	1	1	0.17	2.5
AN <i>Maldanidae</i>	-	-	1	-	1	0.17	2.5
AN <i>Mediomastus acutus</i>	-	-	1	-	1	0.17	2.5
AN <i>Megalomma pigmentum</i>	-	-	-	1	1	0.17	2.5
NE <i>Nemertea</i>	-	-	-	1	1	0.17	2.5
AN <i>Nephtys caecoides</i>	-	-	-	1	1	0.17	2.5
AN <i>Nereis procta</i>	-	-	-	1	1	0.17	2.5
AR <i>Oxyurostylis pacifica</i>	-	-	1	-	1	0.17	2.5

**Appendix G-3. (Cont.).**

**Station B2**

Phylum Species	Replicate				Total	Percent Composition	Density No./m <sup>2</sup>
	B2-I	B2-II	B2-III	B2-IV			
AN <i>Perapriionospio pinnata</i>	-	-	1	-	1	0.17	2.5
AN <i>Pectinaria californiensis</i>	-	-	-	1	1	0.17	2.5
PR <i>Phoronis</i> sp	-	1	-	-	1	0.17	2.5
AR <i>Photis bifurcata</i>	-	1	-	-	1	0.17	2.5
AR <i>Photis californica</i>	-	1	-	-	1	0.17	2.5
AR <i>Pinnixa franciscana</i>	1	-	-	-	1	0.17	2.5
CN <i>Scolanthus</i> sp ASCAMIT 1983	-	1	-	-	1	0.17	2.5
AN <i>Scoletoma</i> sp A (Harris 1985)	-	-	1	-	1	0.17	2.5
AN <i>Scoloplos acmeceps</i>	-	1	-	-	1	0.17	2.5
AN <i>Spirorbis</i> sp	-	1	-	-	1	0.17	2.5
PL <i>Stylochoplana</i> sp	-	-	1	-	1	0.17	2.5
MO <i>Tellina</i> sp B SCAMIT 2001	-	1	-	-	1	0.17	2.5
AN <i>Tenoria priops</i>	-	-	-	1	1	0.17	2.5
AR <i>Zeuxo normani</i>	-	-	-	1	1	0.17	2.5

**Summary**

Parameter	Replicate				Station	Replicate	
	B2-I	B2-II	B2-III	B2-IV		Mean	S.D.
Number of individuals	153	161	78	190	582	145.5	47.7
Number of species	35	35	36	41	83	36.8	2.9
Diversity (H')	2.52	2.40	3.15	2.56	2.87	2.66	0.34

Appendix G-3. (Cont.).

Station B3

Phylum Species	Replicate				Total	Percent Composition	Density No./m <sup>2</sup>
	B3-I	B3-II	B3-III	B3-IV			
AN Oligochaeta	33	22	12	18	85	11.71	212.5
MO Caecum californicum	64	4	8	2	78	10.74	195.0
AN Mediomastus californiensis	21	18	20	17	76	10.47	190.0
AN Mediomastus ambiseta	20	9	4	11	44	6.06	110.0
AN Armandia brevis	6	9	25	1	41	5.65	102.5
AN Scoloplos acmeceps	4	8	1	8	21	2.89	52.5
AN Dorvillea (Schistomerings) annulata	8	2	10	-	20	2.75	50.0
SI Apionsoma misakianum	4	4	6	5	19	2.62	47.5
MO Crepipatella dorsata	7	1	6	-	14	1.93	35.0
AN Maldanidae	3	5	3	3	14	1.93	35.0
AN Sphaerosyllis californiensis	8	3	2	1	14	1.93	35.0
AN Exogone lourei	9	-	4	-	13	1.79	32.5
AN Aricidea (Acmira) catherinae	3	2	3	3	11	1.52	27.5
AN Paradoneis lyra	5	1	3	2	11	1.52	27.5
AN Protodorvillea gracilis	9	-	2	-	11	1.52	27.5
MO Rocheftoria tumida	3	1	1	6	11	1.52	27.5
AN Spiophanes duplex	3	5	2	1	11	1.52	27.5
AN Euclymeninae sp A SCAMIT 1987	2	3	-	5	10	1.38	25.0
AN Prionospio (Prionospio) heterobranchia	1	3	3	3	10	1.38	25.0
NE Tubulanus polymorphus	1	3	4	2	10	1.38	25.0
EC Amphiodia digitata	3	2	4	-	9	1.24	22.5
AR Caprella mendax	6	1	2	-	9	1.24	22.5
NE Monostylifera sp SD 1 Pt Loma 1995	5	4	-	-	9	1.24	22.5
AR Photis brevipes	6	-	2	-	8	1.10	20.0
NE Lineidae	2	3	1	1	7	0.96	17.5
MO Cumingia californica	-	1	4	1	6	0.83	15.0
EC Leptosynapta sp	1	2	2	1	6	0.83	15.0
AN Notomastus hemipodus	3	1	2	-	6	0.83	15.0
AR Aoroides exilis	5	-	-	-	5	0.69	12.5
MO Caecum crebricinctum	1	-	4	-	5	0.69	12.5
AN Monticellina cryptica	1	2	-	2	5	0.69	12.5
PR Phoronis sp	-	4	1	-	5	0.69	12.5
CN Actiniaria	1	-	3	-	4	0.55	10.0
AR Caprella californica	3	-	1	-	4	0.55	10.0
AN Caulerella alata	2	1	1	-	4	0.55	10.0
AN Glycera americana	1	2	1	-	4	0.55	10.0
AN Malmgreniella macginitiei	2	-	1	1	4	0.55	10.0
MO Mysella sp H SCAMIT 2001	2	-	1	1	4	0.55	10.0
NE Paranemertes californica	1	1	2	-	4	0.55	10.0
AN Pista bansei	-	3	1	-	4	0.55	10.0
AN Prionospio (Minusprio) lighti	-	1	3	-	4	0.55	10.0
AN Chaetozone setosa Crmplx	1	-	-	2	3	0.41	7.5
BC Glottidia albida	-	2	1	-	3	0.41	7.5
AN Melinna oculata	-	2	-	1	3	0.41	7.5
AN Micropodarke dubia	-	-	3	-	3	0.41	7.5
NT Nematoda	2	1	-	-	3	0.41	7.5
AN Nereis procera	2	-	-	1	3	0.41	7.5
AN Owenia collaris	-	1	2	-	3	0.41	7.5
AR Rudilemboides stenopropodus	-	1	2	-	3	0.41	7.5
AN Spiophanes bombyx	-	-	1	2	3	0.41	7.5
PL Stylochoplana sp	-	3	-	-	3	0.41	7.5
CN Edward sia sp G MEC 1992	-	2	-	-	2	0.28	5.0
AR Ericthonius brasiliensis	2	-	-	-	2	0.28	5.0
AN Eumida longicornuta	1	-	1	-	2	0.28	5.0
AR Jassa slatteryi	1	1	-	-	2	0.28	5.0
MO Leporimetis obesa	2	-	-	-	2	0.28	5.0
AN Lumbrineris japonica	-	1	1	-	2	0.28	5.0
AN Platynereis bicanaliculata	1	-	1	-	2	0.28	5.0
AN Scoletoma sp C (Harris 1985)	2	-	-	-	2	0.28	5.0
AR Americhelidium rectipalmum	1	-	-	-	1	0.14	2.5
EC Amphiuridae	-	-	1	-	1	0.14	2.5
AN Aphelochaeta glandaria	1	-	-	-	1	0.14	2.5
MO Bivalvia	-	1	-	-	1	0.14	2.5
EP Bowerbankia gracilis	1	-	-	-	1	0.14	2.5
AR Campylaspis rubromaculata	-	1	-	-	1	0.14	2.5
AN Chaetozone columbiana	1	-	-	-	1	0.14	2.5
AN Chone minuta	1	-	-	-	1	0.14	2.5
AR Clausidium vancouverense	1	-	-	-	1	0.14	2.5
MO Collisella ochracea	1	-	-	-	1	0.14	2.5

**Appendix G-3. (Cont.).**

**Station B3**

Phylum Species	Replicate				Total	Percent Composition	Density No./m <sup>2</sup>
	B3-I	B3-II	B3-III	B3-IV			
AR <i>Cumella californica</i>	-	-	1	-	1	0.14	2.5
AR <i>Elasmopus bampo</i>	1	-	-	-	1	0.14	2.5
CO <i>Enteropneusta</i>	-	1	-	-	1	0.14	2.5
AN <i>Glycera nana</i>	1	-	-	-	1	0.14	2.5
AN <i>Glycinde armigera</i>	-	1	-	-	1	0.14	2.5
AN <i>Halosydna johnsoni</i>	1	-	-	-	1	0.14	2.5
AR <i>Heptacarpus palpator</i>	-	-	1	-	1	0.14	2.5
AR <i>Lamprops carinatus</i>	-	1	-	-	1	0.14	2.5
PL <i>Leptoplanidae</i> sp A MEC 1988	-	1	-	-	1	0.14	2.5
AN <i>Malmgreniella</i> sp A SCAMIT 1997	-	-	1	-	1	0.14	2.5
AN <i>Microphthalimus hystrix</i>	1	-	-	-	1	0.14	2.5
AN <i>Neosabellaria cementarium</i>	-	-	1	-	1	0.14	2.5
AR <i>Oxyurostylis pacifica</i>	-	-	-	1	1	0.14	2.5
AN <i>Paleanotus bellis</i>	1	-	-	-	1	0.14	2.5
AR <i>Parasterope hulingsi</i>	-	-	-	1	1	0.14	2.5
AN <i>Pherusa neopapillata</i>	-	-	-	1	1	0.14	2.5
AR <i>Phoxichilidium parvum</i>	-	-	-	1	1	0.14	2.5
AN <i>Phyllodoce</i> sp	-	-	-	1	1	0.14	2.5
AR <i>Podocerus cristatus</i>	1	-	-	-	1	0.14	2.5
AN <i>Praxillella pacifica</i>	1	-	-	-	1	0.14	2.5
MO <i>Rochefortia coeni</i>	-	-	-	1	1	0.14	2.5
AR <i>Rutiderma judayi</i>	-	-	1	-	1	0.14	2.5
AN <i>Saccocirrus</i> sp	1	-	-	-	1	0.14	2.5
MO <i>Saxidomus nuttalli</i>	-	-	1	-	1	0.14	2.5
EC <i>Strongylocentrotus purpuratus</i>	1	-	-	-	1	0.14	2.5
AN <i>Syllis (Ehlersia) heterochaeta</i>	1	-	-	-	1	0.14	2.5
MO <i>Tegelus subteres</i>	-	-	-	1	1	0.14	2.5
NE <i>Tetrastremma</i> sp A SCAMIT 1995	1	-	-	-	1	0.14	2.5
NE <i>Tubulanus nothus</i>	-	-	-	1	1	0.14	2.5
NE <i>Zygonemertes virescens</i>	1	-	-	-	1	0.14	2.5

**Summary**

Parameter	Replicate				Station Total	Replicate	
	B3-I	B3-II	B3-III	B3-IV		Mean	S.D.
Number of individuals	292	151	174	109	726	181.5	78.4
Number of species	65	47	52	34	99	49.5	12.8
Diversity (H')	3.29	3.36	3.43	2.96	3.64	3.26	0.21

Appendix G-3. (Cont.).

Station B4

Phylum Species	Replicate				Total	Percent Composition	Density No./m <sup>2</sup>
	B4-I	B4-II	B4-III	B4-IV			
AN <i>Apophionospio pygmaea</i>	14	12	25	16	67	25.00	167.5
MO <i>Rochefortia coeni</i>	-	1	-	35	36	13.43	90.0
AR <i>Diastylopsis tenuis</i>	2	1	12	2	17	6.34	42.5
AN <i>Mediomastus acutus</i>	2	6	6	2	16	5.97	40.0
AR <i>Rhepoxynius menziesi</i>	3	-	4	8	15	5.60	37.5
AR <i>Gibberosus myersi</i>	1	-	11	1	13	4.85	32.5
AN <i>Spiophanes bombyx</i>	6	6	-	1	13	4.85	32.5
AN <i>Chaetozone setosa</i> Cmplx	2	3	6	1	12	4.48	30.0
AN <i>Spiophanes duplex</i>	3	4	-	1	8	2.99	20.0
AN <i>Owenia collaris</i>	1	1	5	-	7	2.61	17.5
AN <i>Syllis (Typosyllis) farallonensis</i>	3	-	1	3	7	2.61	17.5
CO <i>Enteropneusta</i>	3	-	1	1	5	1.87	12.5
NT <i>Nematoda</i>	1	3	-	1	5	1.87	12.5
AN <i>Nephlys caecoides</i>	1	-	3	1	5	1.87	12.5
AN <i>Armandia brevis</i>	-	1	-	3	4	1.49	10.0
MO <i>Tellina modesta</i>	-	1	2	1	4	1.49	10.0
AN <i>Glycera macrobranchia</i>	-	1	2	-	3	1.12	7.5
AN <i>Magelona sacculata</i>	2	1	-	-	3	1.12	7.5
AN <i>Pectinaria californiensis</i>	1	1	-	1	3	1.12	7.5
MO <i>Rochefortia tumida</i>	1	-	-	2	3	1.12	7.5
AN <i>Aricidea (Acmira) catherinae</i>	2	-	-	-	2	0.75	5.0
AN <i>Monticellina cryptica</i>	-	-	2	-	2	0.75	5.0
AN <i>Amoeana occidentalis</i>	-	-	-	1	1	0.37	2.5
AR <i>Americichelidium shoemakeri</i>	-	-	-	1	1	0.37	2.5
EC <i>Astropecten armatus</i>	1	-	-	-	1	0.37	2.5
AR <i>Caprella californica</i>	-	-	-	1	1	0.37	2.5
NE <i>Carinoma mutabilis</i>	-	1	-	-	1	0.37	2.5
EC <i>Dendraster excentricus</i>	1	-	-	-	1	0.37	2.5
AR <i>Edotia sublittoralis</i>	-	-	-	1	1	0.37	2.5
AN <i>Goniada littorea</i>	-	1	-	-	1	0.37	2.5
AN <i>Halosydna brevisetosa</i>	1	-	-	-	1	0.37	2.5
AR <i>Hemilamprops californicus</i>	-	-	1	-	1	0.37	2.5
EC <i>Leptosynapta</i> sp	-	-	1	-	1	0.37	2.5
MO <i>Macoma</i> sp	-	1	-	-	1	0.37	2.5
AN <i>Mediomastus ambiseta</i>	-	-	-	1	1	0.37	2.5
AN <i>Notomastus hemipodus</i>	-	-	-	1	1	0.37	2.5
CN <i>Pennatulacea</i>	-	-	1	-	1	0.37	2.5
PR <i>Phoronis</i> sp	-	-	1	-	1	0.37	2.5
AN <i>Scoletoma tetraura</i> Cmplx	-	-	-	1	1	0.37	2.5
AN <i>Scoloplos armiger</i>	-	1	-	-	1	0.37	2.5

Summary

Parameter	Replicate				Station Total	Replicate	
	B4-I	B4-II	B4-III	B4-IV		Mean	S.D.
Number of individuals	51	46	84	87	268	67.0	21.5
Number of species	20	18	17	24	40	19.8	3.1
Diversity (H')	2.60	2.45	2.30	2.21	2.85	2.39	0.17

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**Appendix G-3. (Cont.).**

**Station B5**

Phylum Species	Replicate				Total	Percent Composition	Density No./m²
	B5-I	B5-II	B5-III	B5-IV			
AN <i>Owenia collaris</i>	13	13	7	8	41	11.95	102.5
CN <i>Zaolutes actius</i>	9	16	1	3	29	8.45	72.5
AN <i>Apopriionospio pygmaea</i>	5	11	7	2	25	7.29	62.5
EC <i>Dendraster excentricus</i>	8	4	6	4	22	6.41	55.0
AN <i>Spiophanes bombyx</i>	4	6	4	6	20	5.83	50.0
AR <i>Gibberosus myersi</i>	7	5	1	5	18	5.25	45.0
AR <i>Rhepoxynius menziesi</i>	6	1	8	3	18	5.25	45.0
AN <i>Syllis (Typosyllis) farallonensis</i>	4	4	2	4	14	4.08	35.0
AR <i>Diastylopsis tenuis</i>	7	1	5	-	13	3.79	32.5
AN <i>Chaetozona setosa</i> Cmplx	3	5	2	1	11	3.21	27.5
AN <i>Mediomastus acutus</i>	1	2	4	4	11	3.21	27.5
CO <i>Enteropneusta</i>	2	2	1	5	10	2.92	25.0
AR <i>Lamprops quadriplicatus</i>	-	2	-	6	8	2.33	20.0
NE <i>Carinoma mutabilis</i>	4	1	1	1	7	2.04	17.5
MO <i>Tellina modesta</i>	2	1	3	1	7	2.04	17.5
AN <i>Magelona seculata</i>	1	1	-	4	6	1.75	15.0
AN <i>Nephys caecoides</i>	3	1	-	2	6	1.75	15.0
NE <i>Tubulanus polymorphus</i>	4	2	-	-	6	1.75	15.0
AN <i>Goniada littorea</i>	1	1	2	1	5	1.46	12.5
AN <i>Pectinaria californiensis</i>	1	1	1	2	5	1.46	12.5
AN <i>Aricidea (Acmira) catherinae</i>	3	-	1	-	4	1.17	10.0
AN <i>Armandia brevis</i>	1	-	1	1	3	0.87	7.5
AN <i>Glycere macrobranchia</i>	-	2	-	1	3	0.87	7.5
NE <i>Nemertea</i>	1	-	1	1	3	0.87	7.5
MO <i>Rocheffortia coeni</i>	-	-	3	-	3	0.87	7.5
AN <i>Spiochaetopterus costarum</i>	2	-	1	-	3	0.87	7.5
AN <i>Spiophanes duplex</i>	1	-	2	-	3	0.87	7.5
AR <i>Anchicolarurus occidentalis</i>	-	2	-	-	2	0.58	5.0
AR <i>Campylaspis</i> sp C Myers & Benedict 1974	1	1	-	-	2	0.58	5.0
AR <i>Edotia sublittoralis</i>	-	-	1	1	2	0.58	5.0
AN <i>Glycinde armigera</i>	-	1	1	-	2	0.58	5.0
AN <i>Leitoscoloplos pugettensis</i>	1	1	-	-	2	0.58	5.0
NE <i>Lineidae</i>	-	-	1	1	2	0.58	5.0
MO <i>Macoma</i> sp	-	2	-	-	2	0.58	5.0
AN <i>Nephys cornuta</i>	1	-	-	1	2	0.58	5.0
PR <i>Phoronis</i> sp	-	1	-	1	2	0.58	5.0
AN <i>Sigalion spinosus</i>	1	-	-	1	2	0.58	5.0
AR <i>Uromurna ubiquita</i>	1	1	-	-	2	0.58	5.0
AN <i>Aricidea (Acmira) horikoshii</i>	-	-	-	1	1	0.29	2.5
AN <i>Autolytinae</i>	-	-	1	-	1	0.29	2.5
MO <i>Balcis oldroydae</i>	-	-	1	-	1	0.29	2.5
AN <i>Chone mollis</i>	-	1	-	-	1	0.29	2.5
AN <i>Dispia uncinata</i>	1	-	-	-	1	0.29	2.5
EH <i>Echiura</i>	-	1	-	-	1	0.29	2.5
AR <i>Hemilamprops californicus</i>	-	1	-	-	1	0.29	2.5
NE <i>Hoplomeretea</i> sp A Paquette 1988	-	-	-	1	1	0.29	2.5
AR <i>Jassa slatteryi</i>	-	-	1	-	1	0.29	2.5
AR <i>Lepidopa californica</i>	-	-	-	1	1	0.29	2.5
AN <i>Notomastus hemipodus</i>	-	-	-	1	1	0.29	2.5
AN <i>Onuphidae</i>	1	-	-	-	1	0.29	2.5
MO <i>Rocheffortia tumida</i>	1	-	-	-	1	0.29	2.5
AN <i>Scoloplos armiger</i>	1	-	-	-	1	0.29	2.5
MO <i>Solen sicarius</i>	-	-	1	-	1	0.29	2.5
AN <i>Tenonia priops</i>	-	1	-	-	1	0.29	2.5
MO <i>Turbonilla santerosana</i>	-	-	-	1	1	0.29	2.5

**Summary**

Parameter	Replicate				Station	Replicate	
	B5-I	B5-II	B5-III	B5-IV		Mean	S.D.
Number of individuals	102	95	71	75	343	85.8	15.1
Number of species	33	32	29	31	55	31.3	1.7
Diversity ( $H'$ )	3.13	2.96	3.05	3.16	3.39	3.07	0.09

**Appendix G-3. (Cont.).**

**Station B6**

Phylum Species	Replicate				Total	Percent Composition	Density No./m <sup>2</sup>
	B6-I	B6-II	B6-III	B6-IV			
AN <i>Spiophanes bombyx</i>	8	3	5	9	25	9.06	62.5
AR <i>Diestylopsis tenuis</i>	4	13	1	6	24	8.70	60.0
MO <i>Tellina modesta</i>	8	8	6	2	24	8.70	60.0
AN <i>Apoptrionospio pygmaea</i>	5	7	3	5	20	7.25	50.0
AN <i>Mediomastus acutus</i>	7	1	6	6	20	7.25	50.0
AN <i>Syllis (Typosyllis) farallonensis</i>	2	8	4	3	17	6.16	42.5
AR <i>Rhepoxynius menziesi</i>	2	6	2	5	15	5.43	37.5
AN <i>Spiophanes duplex</i>	4	1	7	1	13	4.71	32.5
AN <i>Monticellina cryptica</i>	3	3	2	4	12	4.35	30.0
AR <i>Gibberosus myersi</i>	1	6	4	-	11	3.99	27.5
AN <i>Sigalion spinosus</i>	5	2	1	1	9	3.26	22.5
EC <i>Dendraster excentricus</i>	3	1	2	2	8	2.90	20.0
AN <i>Chaetozone setosa</i> Cmplx	1	2	1	2	6	2.17	15.0
CO <i>Enteropneusta</i>	2	-	3	1	6	2.17	15.0
AR <i>Americhelidium shoemakeri</i>	-	4	1	-	5	1.81	12.5
AN <i>Nephtys caecoides</i>	3	1	1	-	5	1.81	12.5
NE <i>Carinoma mutabilis</i>	2	1	1	-	4	1.45	10.0
NT <i>Nematoda</i>	1	-	1	2	4	1.45	10.0
PR <i>Phoronis</i> sp	-	-	2	2	4	1.45	10.0
MO <i>Acteocina harpa</i>	-	-	3	-	3	1.09	7.5
AN <i>Autolytinae</i>	-	2	-	1	3	1.09	7.5
MO <i>Acteocina culcitella</i>	-	2	-	-	2	0.72	5.0
AN <i>Exogone ligurei</i>	1	-	-	1	2	0.72	5.0
AN <i>Gonidea littorea</i>	-	2	-	-	2	0.72	5.0
AR <i>Lamprops quadriplicatus</i>	-	1	-	1	2	0.72	5.0
NE <i>Lineidae</i>	-	1	-	1	2	0.72	5.0
MO <i>Macoma yoldiformis</i>	-	1	1	-	2	0.72	5.0
AN <i>Magelona sacculata</i>	1	-	-	1	2	0.72	5.0
AN <i>Mediomastus ambiseta</i>	-	-	-	2	2	0.72	5.0
AN <i>Nephtys cornuta</i>	-	1	1	-	2	0.72	5.0
AR <i>Argisso hamatipes</i>	1	-	-	-	1	0.36	2.5
AR <i>Cerapus tubularis</i> Cmplx	-	-	-	1	1	0.36	2.5
AN <i>Chone mollis</i>	-	-	1	-	1	0.36	2.5
AN <i>Chone</i> sp SD 1 Pt. Loma 1997	-	-	1	-	1	0.36	2.5
MO <i>Ennucula tenuis</i>	-	-	1	-	1	0.36	2.5
AN <i>Eteone californica</i>	-	-	-	1	1	0.36	2.5
AR <i>Hartmanodes hartmanae</i>	-	-	1	-	1	0.36	2.5
AR <i>Hemilamprops californicus</i>	-	-	-	1	1	0.36	2.5
AR <i>Incisocalliope bairdi</i>	-	-	-	1	1	0.36	2.5
AR <i>Leuroleberis sharpei</i>	-	-	1	-	1	0.36	2.5
MO <i>Macoma</i> sp	-	-	-	1	1	0.36	2.5
NE <i>Monostylifera</i> sp SD 1 Pt Loma 1995	1	-	-	-	1	0.36	2.5
NE <i>Nemertea</i>	-	-	-	1	1	0.36	2.5
MO <i>Olivella baetica</i>	-	-	-	1	1	0.36	2.5
AN <i>Pectinaria californiensis</i>	-	1	-	-	1	0.36	2.5
MO <i>Periploma planiusculum</i>	-	1	-	-	1	0.36	2.5
MO <i>Rochefortia tumida</i>	-	-	-	1	1	0.36	2.5
AN <i>Tenonia priops</i>	-	-	1	-	1	0.36	2.5
NE <i>Tubulanus polymorphus</i>	-	-	1	-	1	0.36	2.5
AR <i>Uromunna ubiquita</i>	-	-	-	1	1	0.36	2.5

**Summary**

Parameter	Replicate				Station	Replicate	
	B6-I	B6-II	B6-III	B6-IV		Total	Mean
Number of individuals	65	79	65	67	276	69.0	6.7
Number of species	21	25	29	30	50	26.3	4.1
Diversity (H')	2.80	2.84	3.10	3.09	3.30	2.96	0.16

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**Appendix G-3. (Cont.).**

**Station B7**

Phylum Species	Replicate				Total	Percent Composition	Density No./m <sup>2</sup>
	B7-I	B7-II	B7-III	B7-IV			
AN <i>Apopriionospio pygmaea</i>	20	19	24	11	74	19.63	185.0
AN <i>Spiophanes bombyx</i>	7	15	11	12	45	11.94	112.5
AN <i>Pectinaria californiensis</i>	6	10	-	9	25	6.63	62.5
AR <i>Rhepoxynius menziesi</i>	13	2	4	6	25	6.63	62.5
AN <i>Mediomastus acutus</i>	1	3	10	2	16	4.24	40.0
AN <i>Megelona sacculata</i>	1	4	3	7	15	3.98	37.5
EC <i>Dendraster excentricus</i>	2	5	-	6	13	3.45	32.5
AR <i>Diastylopsis tenuis</i>	4	4	-	5	13	3.45	32.5
AN <i>Syllis (Typosyllis) farallonensis</i>	-	6	7	-	13	3.45	32.5
AN <i>Spiophanes duplex</i>	-	4	2	5	11	2.92	27.5
AN <i>Chaetozone setosa</i> Cmplx	4	1	4	1	10	2.65	25.0
AN <i>Spiochaetopterus costarum</i>	1	4	-	4	9	2.39	22.5
MO <i>Tellina modesta</i>	5	2	1	1	9	2.39	22.5
AR <i>Hartmanodes hartmanae</i>	4	2	1	1	8	2.12	20.0
AR <i>Gibberosus myersi</i>	3	1	3	-	7	1.86	17.5
CN <i>Zeolutes actius</i>	2	-	-	5	7	1.86	17.5
AN <i>Nephtys caecoides</i>	3	1	2	-	6	1.59	15.0
NE <i>Carinoma mutabilis</i>	1	2	1	1	5	1.33	12.5
CO <i>Enteropneusta</i>	1	-	-	3	4	1.06	10.0
AN <i>Goniada littorea</i>	2	-	-	2	4	1.06	10.0
AN <i>Megelona pitelkai</i>	-	-	2	2	4	1.06	10.0
AN <i>Aricidea (Acmina) catherinae</i>	1	2	-	-	3	0.80	7.5
AN <i>Dispia uncinata</i>	1	-	-	2	3	0.80	7.5
AN <i>Glycera macrobranchia</i>	-	2	1	-	3	0.80	7.5
AN <i>Mediomastus ambiseta</i>	1	1	-	1	3	0.80	7.5
PR <i>Phoronis</i> sp	-	1	-	2	3	0.80	7.5
AR <i>Photis</i> OC 1 Diener 1992	3	-	-	-	3	0.80	7.5
AN <i>Phyllocoete hartmanae</i>	2	1	-	-	3	0.80	7.5
AR <i>Aoroides</i> sp	-	-	1	1	2	0.53	5.0
AN <i>Armandia brevis</i>	-	2	-	-	2	0.53	5.0
AN <i>Autolytinae</i>	-	1	1	-	2	0.53	5.0
MO <i>Cooperella subdiaphana</i>	-	1	-	1	2	0.53	5.0
MO <i>Macoma</i> sp	-	-	-	2	2	0.53	5.0
AR <i>Neotrypaea californiensis</i>	-	1	-	1	2	0.53	5.0
NE <i>Paranemertes californica</i>	1	-	-	1	2	0.53	5.0
MO <i>Rochefortia tumida</i>	-	-	1	1	2	0.53	5.0
MO <i>Siliqua lucida</i>	-	-	-	2	2	0.53	5.0
MO <i>Acteocina harpa</i>	1	-	-	-	1	0.27	2.5
AR <i>Americhelidium shoemakeri</i>	-	-	-	1	1	0.27	2.5
AN <i>Chone</i> sp SD 1 Pt. Loma 1997	-	1	-	-	1	0.27	2.5
AR <i>Lamprops quadriplicatus</i>	1	-	-	-	1	0.27	2.5
AN <i>Leitoscoloplos pugettensis</i>	1	-	-	-	1	0.27	2.5
NE <i>Lineidae</i>	-	1	-	-	1	0.27	2.5
AN <i>Onuphis</i> sp 1 Pt. Loma 1983	-	1	-	-	1	0.27	2.5
CN <i>Pennatulacea</i>	1	-	-	-	1	0.27	2.5
AN <i>Podarkeopsis glabra</i>	1	-	-	-	1	0.27	2.5
AN <i>Prionospio (Minuspio) lighti</i>	-	-	-	1	1	0.27	2.5
AN <i>Scoletocone</i> sp	-	1	-	-	1	0.27	2.5
AN <i>Scoloplos armiger</i>	-	-	1	-	1	0.27	2.5
AN <i>Syllis (Ehlersia) heterochaeta</i>	-	-	-	1	1	0.27	2.5
NE <i>Tubulanus polymorphus</i>	-	-	1	-	1	0.27	2.5
MO <i>Turbonilla santarosana</i>	-	-	-	1	1	0.27	2.5

**Summary**

Parameter	Replicate				Station	Replicate	
	B7-I	B7-II	B7-III	B7-IV		Total	Mean
Number of individuals	94	101	81	101	377	94.3	9.4
Number of species	29	30	20	32	52	27.8	5.3
Diversity (H')	2.87	2.90	2.41	3.09	3.17	2.81	0.29

**Appendix G-4. Infaunal wet weight biomass data (g). AES Redondo Beach L.L.C.  
generating station NPDES, 2001.**

Sta-Rep	Annelida	Arthropoda	Mollusca	Echinodermata	Misc.	Total
B1-I	0.710	0.013	0.096	0.740	0.298	1.857
B1-II	0.960	0.076	0.170	0.148	0.302	1.656
B1-III	0.826	0.056	2.568	0.822	0.249	4.521
B1-IV	0.954	0.021	0.497	0.101	0.118	1.691
Total	3.450	0.166	3.331	1.811	0.967	9.725
B2-I	1.127	0.005	1.559	0.038	0.080	2.809
B2-II	0.969	0.005	0.030	0.042	0.037	1.083
B2-III	0.379	0.007	-	0.132	0.085	0.603
B2-IV	0.471	0.047	0.016	0.070	0.010	0.614
Total	2.946	0.064	1.605	0.282	0.212	5.109
B3-I	0.333	0.012	0.543	0.326	0.012	1.226
B3-II	0.721	<0.001	0.373	0.049	0.196	1.339
B3-III	0.686	0.021	0.463	0.290	0.185	1.645
B3-IV	0.947	<0.001	0.814	0.120	0.024	1.905
Total	2.687	0.033	2.193	0.785	0.417	6.115
B4-I	0.036	0.003	0.017	3.012	0.013	3.081
B4-II	0.173	<0.001	0.008	-	<0.001	0.181
B4-III	0.082	0.021	0.003	0.116	0.052	0.274
B4-IV	0.371	0.012	0.036	-	0.116	0.535
Total	0.662	0.036	0.064	3.128	0.181	4.071
B5-I	0.046	0.005	0.005	<0.001	0.206	0.262
B5-II	0.142	0.003	0.001	<0.001	0.018	0.164
B5-III	0.265	0.002	0.008	<0.001	0.068	0.343
B5-IV	0.231	0.022	0.017	<0.001	0.027	0.297
Total	0.684	0.032	0.031	<0.001	0.319	1.066
B6-I	0.377	<0.001	0.005	<0.001	0.060	0.442
B6-II	0.024	0.007	0.013	<0.001	0.003	0.047
B6-III	0.280	<0.001	0.005	0.001	0.008	0.294
B6-IV	0.254	0.015	0.002	<0.001	0.018	0.289
Total	0.935	0.022	0.025	0.001	0.089	1.072
B7-I	0.197	0.014	0.002	<0.001	0.035	0.248
B7-II	0.054	0.012	0.010	0.002	0.010	0.088
B7-III	0.189	0.012	0.004	-	<0.001	0.205
B7-IV	0.078	0.034	0.009	0.022	0.051	0.194
Total	0.518	0.072	0.025	0.024	0.096	0.735
<b>Grand Total</b>	<b>11.882</b>	<b>0.425</b>	<b>7.274</b>	<b>6.031</b>	<b>2.281</b>	<b>27.893</b>

Note: - = no animals

**Appendix G-5. Yearly infauna abundance. AES Redondo Beach L.L.C. generating stations NPDES, 1972-2001.**

Phylum	Species	1972	1978	1980	1986	1988	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	Total
NT	Nematoda	-	35	3	28	1	27	30	17	23	24	1651	57	77	1845	57	3875
AN	Oligochaeta	473	249	-	22	76	281	425	283	292	441	167	112	12	415	329	3577
AN	<i>Mediomastus</i> spp	-	7	6	16	57	243	279	371	358	569	271	142	133	727	-	3179
MO	<i>Caecum crebricinctum</i>	7	6	5	76	397	172	306	179	557	61	139	22	10	36	53	2026
AN	<i>Armandia brevis</i>	449	1030	12	1	-	-	116	-	1	82	1	10	1	9	159	1871
AN	<i>Prionospio (Minuspio) lighti</i>	233	7	5	2	79	774	97	17	89	278	70	7	7	128	31	1824
AN	<i>Saccocirrus</i> sp	-	-	3	262	57	609	516	197	35	-	-	-	28	38	1	1746
AR	<i>Zeuxo normani</i>	8	1	-	-	-	12	21	6	1596	8	18	44	4	20	7	1745
AN	<i>Apopriospio pygmaea</i>	634	16	11	-	47	34	90	7	70	207	27	166	5	15	195	1524
MO	<i>Caecum californicum</i>	12	18	19	16	286	18	162	209	218	83	93	100	69	87	112	1502
EC	<i>Dendraster excentricus</i>	234	-	3	11	61	16	56	602	48	12	101	-	12	43	44	1243
AN	<i>Pseudopolydora paucibranchiata</i>	1131	-	-	-	-	-	-	-	-	-	-	2	-	29	4	1166
AR	<i>Leptochelia dubia</i>	750	9	4	-	-	53	51	39	35	-	3	20	5	6	1	976
AR	<i>Rudilimboidea stenopropodus</i>	-	13	4	1	5	96	25	205	125	110	168	87	49	41	15	944
AN	<i>Capitella capitata</i> Cmpbx	408	290	186	-	-	4	3	-	1	1	-	-	-	37	2	932
AN	<i>Hesionura coineaui difficilis</i>	273	-	-	5	-	170	100	84	128	-	-	-	60	78	-	898
AN	<i>Spiophanes bombyx</i>	47	7	23	7	30	55	55	12	85	340	46	21	11	28	111	878
AN	<i>Protodorvillea gracilis</i>	143	4	2	13	165	-	98	85	235	95	16	1	3	-	11	871
AN	<i>Mediomastus ambiseta</i>	356	-	48	-	-	-	-	-	-	-	-	-	-	-	390	794
AN	<i>Sphaerosyllis californiensis</i>	-	-	1	1	3	17	39	106	64	91	83	71	34	159	35	704
MO	<i>Tellina modesta</i>	259	20	86	3	6	17	22	5	31	75	7	27	6	12	44	620
AR	<i>Diastylopsis tenuis</i>	70	65	139	31	25	32	43	15	47	27	2	12	17	17	67	609
AR	<i>Jassa slatteryi</i>	97	-	-	2	6	2	-	-	105	3	18	356	-	4	7	600
AN	<i>Owenia collaris</i>	1	3	33	1	1	9	78	1	11	235	53	13	34	50	52	575
AN	<i>Dorvillea (Schistomerings) longicornis</i>	189	15	8	-	8	160	4	78	35	31	35	-	-	-	-	563
AN	<i>Nephtys cornuta</i>	409	-	-	-	2	6	7	2	7	38	22	6	7	17	26	549
AN	<i>Prionospio (Prionospio) heterobranchia</i>	6	1	1	6	12	91	22	20	19	24	64	28	8	147	42	491
AR	<i>Amphideutopus oculatus</i>	17	26	2	2	2	62	15	157	6	14	80	79	3	16	-	481
AR	<i>Mayerella banksia</i>	-	2	1	1	-	2	5	41	47	106	49	187	9	30	1	481
AN	<i>Magelona sacculata</i>	33	-	150	6	145	9	55	25	1	-	-	-	-	-	26	450
NE	<i>Nemertea</i>	260	8	12	-	41	10	11	32	20	11	3	2	10	21	8	449
AR	<i>Rhepoxynius menziesi</i>	28	34	82	15	29	17	26	6	46	61	-	-	7	15	73	439
NE	<i>Paranemertes californica</i>	-	-	16	13	17	9	43	99	31	76	42	26	8	17	20	417
AN	<i>Ophiodromus pugettensis</i>	113	-	-	-	93	83	26	34	8	1	5	-	39	1	403	
AN	<i>Chaetozone setosa</i> Cmplx	-	38	13	7	18	4	7	19	18	61	6	9	58	75	43	376
NE	<i>Tubulanus polymorphus</i>	-	-	-	-	4	37	31	47	23	48	41	19	23	33	39	345
AR	<i>Caprella mendax</i>	-	-	6	1	-	-	3	4	-	8	-	-	46	252	10	330
AR	<i>Cumella californica</i>	-	2	-	1	2	10	5	15	2	26	6	13	42	194	2	320
AR	<i>Ericthonius brasiliensis</i>	60	-	-	-	-	3	1	3	119	33	14	43	10	22	9	317
AN	<i>Leitoscoloplos pugettensis</i>	122	2	12	-	6	-	3	10	33	29	9	46	12	14	17	315
AN	<i>Dorvillea (Schistomerings) annulata</i>	-	-	-	-	-	-	-	-	-	-	-	35	12	136	111	294
AN	<i>Exogone lourei</i>	9	8	4	-	8	9	29	16	11	22	13	7	2	101	52	291
MO	<i>Crepidatella dorsata</i>	-	-	-	-	10	63	-	11	123	6	28	4	1	12	31	289
AR	<i>Acuminodeutopus heteruropus</i>	1	-	-	-	1	-	20	73	2	36	-	83	17	49	5	287
AN	<i>Pectinaria californiensis</i>	35	34	1	-	47	6	3	-	6	94	19	-	2	3	36	286
AN	<i>Lumbrineris</i> spp	135	9	3	1	24	23	20	33	35	-	1	-	-	-	-	284
AR	<i>Monocorophium acherusicum</i>	194	28	3	6	3	6	-	1	9	1	5	20	1	6	-	283
AN	<i>Spiophanes duplex</i>	36	3	7	-	16	4	15	19	41	48	10	8	4	3	62	276
AR	<i>Gibberosus myersi</i>	16	11	13	4	7	25	7	13	24	35	9	2	27	32	49	274
AR	<i>Harpacticoida</i>	-	-	4	1	-	-	8	5	123	54	-	57	-	15	2	269
CN	<i>Actiniaaria</i>	21	-	1	-	-	11	5	6	2	57	2	8	-	-	140	253
NE	<i>Carinoma mutabilis</i>	-	-	10	4	12	15	31	51	11	27	15	4	21	28	17	246
AN	<i>Mediomastus acutus</i>	2	33	19	-	-	-	-	-	-	-	15	28	57	14	65	233
AN	<i>Notomastus</i> sp A SCAMIT 2001	78	54	55	1	12	-	4	5	4	6	7	3	-	-	1	230
AN	<i>Chaetozone corona</i>	212	-	3	-	-	-	-	-	-	-	-	-	1	-	216	
AN	<i>Goniada littorea</i>	55	21	33	2	16	5	12	2	5	7	13	4	22	7	12	216
AR	<i>Podocerus cristatus</i>	-	-	-	-	-	-	-	156	-	2	46	-	-	1	205	
AR	<i>Photis brevipes</i>	26	-	-	-	9	17	39	3	8	31	1	20	13	4	33	204
AN	<i>Scoloplos acmeceps</i>	-	3	-	6	16	3	34	14	-	26	8	5	25	24	35	199
MO	<i>Laevicardium substratum</i>	3	-	1	-	2	19	37	7	8	42	11	8	3	51	2	194
CO	<i>Enteropneusta</i>	-	5	5	-	9	4	10	25	9	17	13	9	11	43	30	190
AN	<i>Tharyx parvus</i>	186	-	-	-	-	-	-	-	-	-	-	-	-	-	-	186
AN	<i>Polyopthalmus pictus</i>	11	6	1	1	3	10	6	18	22	7	10	10	-	76	-	181
NE	<i>Lineidae</i>	-	-	-	2	-	6	14	27	23	24	-	14	9	30	29	178
AR	<i>Rhepoxynius abronius</i>	-	6	10	6	7	4	21	2	66	54	-	-	-	-	-	176
MO	<i>Caecum occidentale</i>	-	5	-	-	30	1	1	19	91	4	5	1	-	1	-	158
AR	<i>Photis bifurcata</i>	6	-	-	-	-	21	6	45	11	18	24	14	3	6	2	156
AR	<i>Photis</i> sp	96	21	11	5	3	7	7	-	-	4	1	-	-	1	-	156
AN	<i>Mediomastus californiensis</i>	-	4	22	-	-	-	-	-	-	-	-	-	-	-	129	155
AN	<i>Micropodarke dubia</i>	-	5	26	5	-	-	-	-	2	62	17	-	1	22	14	154
SI	<i>Apionsoma misakianum</i>	-	-	-	-	-	-	1	10	28	13	33	-	22	21	22	150
AN	<i>Microphthalmus hystrix</i>	-	13	-	7	-	-	-	21	57	16	-	-	-	35	3	149
AR	<i>Uromunna ubiquita</i>	74	3	1	-	-	1	2	1	19	10	10	19	1	3	3	147
AN	<i>Pareurythoe californica</i>	-	-	1	5	41	-	-	43	54	-	-	-	-	-	-	144
AN	<i>Brania</i> sp	4	-	1	-	5	7	20	3	75	23	-	-	-	-	-	138
AN	<i>Nephtys caecoides</i>	11	9	2	-	6	8	22	2	15	13	1	18	2	4	23	136
AR	<i>Aoroides inermis</i>	-	-	-	-	-	-	-	-	13	-	1	71	50	-	-	135
AN	<i>Notomastus hemipodus</i>	-	-	-	-	-	-	-	-	1	-	-	-	10	122	133	

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**Appendix G-5. (Cont.).**

Phylum	Species	1972	1978	1980	1986	1988	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	Total	
MO	<i>Theora lubrica</i>	-	-	-	-	-	-	-	-	41	16	7	65	2	-	-	131	
AN	<i>Caulerfiella alata</i>	-	-	-	14	42	9	3	21	6	8	-	-	13	9	-	125	
MO	<i>Haminoea vesicula</i>	2	62	3	2	2	24	-	4	6	3	14	-	-	3	-	125	
AR	<i>Mandibulophoxus gilesi</i>	-	-	33	-	53	9	2	26	-	-	-	-	-	1	-	124	
MO	<i>Tagelus californianus</i>	6	-	1	-	-	-	-	-	-	-	-	61	-	53	-	121	
AR	<i>Aoroides columbiae</i>	60	49	10	-	1	-	-	-	-	-	-	-	-	-	-	120	
MO	<i>Bivalvia</i>	26	3	1	-	-	13	25	3	22	15	2	1	-	6	2	119	
AR	<i>Hartmanodes hartmanae</i>	3	-	2	1	4	11	14	1	24	13	8	18	3	6	9	117	
MO	<i>Acteocina inculta</i>	111	-	-	-	-	-	-	-	-	-	-	-	-	-	-	111	
PR	<i>Phoronida</i>	-	2	-	-	5	9	8	10	17	38	7	6	-	3	4	109	
AN	<i>Euclymeninæ sp A SCAMIT 1987</i>	-	-	-	-	-	-	17	22	1	13	-	-	-	34	20	107	
AN	<i>Syllis (Typosyllis) farallonensis</i>	-	-	-	1	-	-	-	-	-	6	9	2	6	31	51	106	
MO	<i>Rochefortia tumida</i>	-	10	-	-	-	8	11	5	6	13	11	2	1	19	20	106	
AN	<i>Monticellina cryptica</i>	-	-	-	-	-	-	3	7	5	10	8	12	9	21	30	105	
AN	<i>Tubificoides gabriellae</i>	-	-	101	-	-	-	-	-	-	-	-	-	-	-	-	101	
AN	<i>Nereis procta</i>	27	2	-	-	4	12	7	7	3	5	14	9	4	-	6	100	
AR	<i>Aoroides exilis</i>	-	-	-	3	-	43	-	-	9	-	-	-	5	12	27	99	
MO	<i>Mytilidae</i>	2	-	2	3	13	-	2	-	8	6	4	41	-	16	1	98	
AR	<i>Nebalia daytoni</i>	5	1	81	-	-	-	4	-	-	2	1	2	-	-	1	97	
AR	<i>Lamprops quadriplicatus</i>	1	11	1	-	-	11	15	8	1	21	-	-	-	17	11	96	
AN	<i>Spiochaetopterus costarum</i>	4	2	6	-	10	13	6	4	21	5	4	5	-	3	12	95	
AN	<i>Scolelepis squamata</i>	86	-	-	-	1	-	-	-	-	-	-	-	-	4	-	91	
AN	<i>Paradoneis lyra</i>	-	-	-	-	-	3	5	11	35	19	-	-	6	-	11	90	
AR	<i>Ampithoe plumulosa</i>	-	-	-	-	-	-	-	1	26	-	-	63	-	-	-	90	
AN	<i>Syllis (Typosyllis) spp</i>	15	1	-	2	19	27	18	-	2	5	-	-	-	-	-	89	
AR	<i>Edotia sublitoralis</i>	27	2	4	3	-	3	8	3	4	1	12	9	5	4	3	88	
AN	<i>Eranno lagunae</i>	-	-	-	-	-	-	-	-	-	-	33	23	31	-	-	87	
AN	<i>Paraproniopsis pinnata</i>	12	4	2	-	-	13	2	6	27	6	1	7	4	1	1	86	
AN	<i>Heteropodarke heteromorpha</i>	-	-	-	10	2	-	39	6	17	6	-	-	5	-	-	85	
AN	<i>Prionospio (Prionospio) jubata</i>	-	-	-	-	31	8	5	2	11	8	8	1	2	9	-	85	
MO	<i>Olivella baetica</i>	29	3	2	1	5	5	2	17	5	6	-	1	1	7	1	85	
AN	<i>Lumbrineris japonica</i>	-	-	1	-	2	-	-	-	4	17	38	-	3	13	6	84	
AN	<i>Phyllodoce spp</i>	43	20	4	1	-	4	-	1	1	6	-	-	-	3	1	84	
AN	<i>Magelona pitelkai</i>	-	1	1	-	36	18	10	13	-	-	-	-	-	-	4	83	
AN	<i>Polydora cirrosa</i>	-	-	-	-	-	-	-	-	-	31	-	45	-	7	-	83	
CN	<i>Diadumene sp</i>	4	79	-	-	-	-	-	-	-	-	-	-	-	-	-	83	
AR	<i>Hornellia occidentalis</i>	-	-	-	5	-	13	-	-	33	3	1	23	-	1	2	81	
AN	<i>Platynereis bicanaliculata</i>	15	9	4	-	1	15	10	2	3	5	2	4	-	4	3	77	
AN	<i>Scoletoma tetraura Cmplx</i>	-	2	14	-	-	1	-	4	12	33	1	2	6	1	1	77	
AR	<i>Cumella sp</i>	77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	77	
AN	<i>Cossura candida</i>	5	-	-	-	3	7	-	-	49	11	-	-	-	1	-	76	
AN	<i>Ampharete labrops</i>	-	4	2	1	3	-	10	3	2	29	5	10	4	1	1	75	
AN	<i>Anatomastus gordiodes</i>	-	1	-	-	4	6	2	1	10	20	9	8	11	3	-	75	
AR	<i>Euphilomedes sp</i>	74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	74	
EC	<i>Echinoidea</i>	36	31	1	-	3	1	-	-	1	-	-	-	-	-	-	1	74
AR	<i>Hemilamprops californicus</i>	4	3	-	2	10	1	3	5	17	12	-	3	7	3	3	73	
AN	<i>Aricidea (Acmira) catherinae</i>	-	5	8	1	5	1	1	2	3	10	1	-	2	12	21	72	
AR	<i>Paramicrodeutopus schmitti</i>	1	-	-	-	-	3	-	-	61	1	-	1	-	2	1	70	
MO	<i>Cooperella subdiaphana</i>	6	-	3	-	4	2	9	4	5	13	-	4	1	17	2	70	
MO	<i>Tagelus subteres</i>	1	-	1	-	-	15	1	4	19	16	5	-	6	-	1	69	
CN	<i>Edwardsia sp G MEC 1992</i>	-	-	2	3	11	-	6	15	3	18	4	-	-	3	2	67	
NE	<i>Tetrasistema sp</i>	-	-	-	-	-	-	1	9	12	37	-	6	2	2	-	67	
AN	<i>Axiothella rubrocincta</i>	-	-	9	-	-	-	-	-	7	1	47	-	-	2	-	66	
AN	<i>Phyllodoce hartmanae</i>	-	-	-	-	11	5	12	7	-	8	4	2	3	7	5	64	
AN	<i>Podarkeopsis glabrus</i>	-	1	8	1	13	13	2	3	6	6	2	-	4	3	-	64	
AN	<i>Scoloplos armiger Cmplx</i>	-	1	25	-	3	-	17	5	1	8	-	-	1	3	-	64	
CN	<i>Zaolotus actius</i>	-	1	1	-	2	-	17	-	-	-	5	-	-	2	36	64	
AR	<i>Gammaridea</i>	2	11	12	-	2	1	3	-	23	2	-	4	-	1	1	62	
AR	<i>Pycnogonida</i>	59	3	-	-	-	-	-	-	-	-	-	-	-	-	-	62	
AN	<i>Notomastus sp</i>	4	-	-	-	-	24	3	4	-	1	6	1	18	-	-	61	
AN	<i>Chone mollis</i>	2	2	1	-	8	1	-	2	9	18	9	-	1	5	2	60	
AN	<i>Phyllodoce longipes</i>	-	-	-	-	7	12	15	4	4	6	7	4	-	1	-	60	
AR	<i>Photis macinerneyi</i>	-	-	-	-	1	-	1	8	11	35	2	-	-	2	-	60	
MO	<i>Acteocina harpa</i>	-	1	11	-	-	9	-	2	1	10	17	-	1	7	59		
MO	<i>Protothaca staminea</i>	20	-	-	-	1	12	-	-	4	-	-	6	-	13	3	59	
NE	<i>Tetrasistema sp A SCAMIT 1995</i>	-	-	-	-	-	-	-	-	-	-	32	18	4	3	2	59	
AN	<i>Praxillella pacifica</i>	-	-	-	-	-	-	-	17	1	1	-	5	23	7	4	58	
AN	<i>Hesionella mccullochae</i>	-	-	4	-	-	10	-	-	-	-	11	4	3	24	1	57	
AN	<i>Syllidae</i>	24	5	2	-	1	-	-	-	23	-	-	-	-	2	-	57	
AR	<i>Anoplodactylus erectus</i>	-	-	-	-	16	1	2	-	1	4	1	1	3	24	1	54	
MO	<i>Crenella decussata</i>	52	1	-	-	-	-	-	-	-	-	-	-	-	-	-	53	
AN	<i>Tharyx spp</i>	4	18	6	1	11	10	-	2	-	-	-	-	-	2	2	52	
AR	<i>Elasmopus bampo</i>	-	-	-	-	-	-	-	-	45	-	3	-	-	2	2	52	
AR	<i>Joeropsis dubia</i>	12	-	-	-	-	-	-	-	8	-	3	2	-	6	21	52	
AR	<i>Oxyurostylix pacifica</i>	2	1	6	1	2	4	2	9	3	1	8	6	-	4	3	52	
MO	<i>Leptoplecten latiauratus</i>	3	-	1	-	-	-	2	1	2	4	5	6	4	6	5	51	
MO	<i>Macoma yoldiformis</i>	3	7	2	-	-	-	2	1	2	-	2	-	5	-	7	51	
MO	<i>Siliqua lucida</i>	26	2	4	-	1	-	-	2	-	2	-	5	-	7	2	51	

**Appendix G-5. (Cont.).**

Phylum	Species	1972	1978	1980	1986	1988	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	Total	
NE	<i>Cerebratulus californiensis</i>	-	-	-	-	3	5	-	2	1	-	37	-	-	3	-	51	
AN	Hesionidae	-	-	-	-	-	23	27	-	-	-	-	-	-	-	-	50	
AR	<i>Maera similis</i>	-	-	-	-	-	4	-	-	27	-	-	3	-	-	16	50	
PL	<i>Stylochoplana</i> sp	-	-	1	-	9	1	3	9	2	12	4	2	-	-	5	48	
AN	<i>Pista disjuncta</i>	-	-	-	-	21	5	-	1	-	8	3	3	-	4	2	47	
EC	<i>Amphiodia digitata</i>	-	-	-	-	-	-	-	3	3	1	4	1	11	3	21	47	
AN	Maldanidae	7	-	-	-	-	-	-	-	1	1	-	2	3	12	20	46	
AN	<i>Tenonia priops</i>	-	6	-	1	6	4	5	6	3	5	6	-	-	1	3	46	
AN	<i>Sigalion spinosus</i>	1	2	3	3	2	1	2	1	6	3	2	1	6	1	11	45	
AR	<i>Neotrypaea californiensis</i>	1	3	-	2	20	5	3	5	-	2	-	-	2	-	2	45	
AN	<i>Glycera macrobranchia</i>	-	-	2	-	1	6	2	4	-	7	1	7	1	4	9	44	
AN	<i>Glycera</i> sp	12	-	5	-	1	-	2	-	-	-	-	-	-	24	-	44	
AN	<i>Pisone remota</i>	-	-	-	1	-	25	-	2	8	-	-	-	8	-	-	44	
AR	<i>Americhelidium shoemakeri</i>	-	2	-	-	-	1	14	7	2	5	3	-	1	2	7	44	
AN	Cirratulidae	39	-	1	-	-	-	-	-	-	-	-	-	1	-	1	43	
AR	<i>Monocorophium</i> sp	5	37	1	-	-	-	-	-	-	-	-	-	-	-	-	43	
CO	<i>Neoclinus</i> sp	-	-	43	-	-	-	-	-	-	-	-	-	-	-	-	43	
MO	<i>Modiolus</i> sp	1	2	-	-	-	-	25	4	1	1	-	3	5	1	-	43	
MO	<i>Rocheftoria coeni</i>	-	-	-	-	-	-	-	-	2	-	-	-	-	-	41	43	
EC	<i>Leptosynapta</i> sp	-	-	1	-	3	14	-	3	-	2	2	2	1	-	7	9	42
MO	<i>Haminoea</i> sp	-	-	-	-	-	-	42	-	-	-	-	-	-	-	-	42	
AR	<i>Americhelidium</i> sp	38	1	2	-	-	-	-	-	-	-	-	-	-	-	-	41	
AR	<i>Anchicolarus occidentalis</i>	-	-	3	-	6	2	-	4	1	1	2	-	6	13	2	40	
AR	<i>Lophopanopeus</i> sp	-	-	-	-	-	35	-	-	4	-	-	-	1	-	-	40	
AN	<i>Glycera nana</i>	-	-	-	-	3	10	1	3	6	-	2	-	10	2	1	38	
CO	<i>Branchiostoma californiense</i>	11	-	-	-	-	3	4	1	1	-	2	-	-	16	-	38	
MO	<i>Saxidomus nuttalli</i>	-	7	1	-	-	3	-	-	8	4	-	-	1	9	4	37	
AN	<i>Eumida longicornuta</i>	12	-	-	-	-	-	10	-	2	3	4	-	-	1	4	36	
AN	<i>Glycera americana</i>	-	-	-	-	-	8	8	-	5	3	2	-	-	4	6	36	
AN	<i>Lumbineris californiensis</i>	-	-	-	-	2	-	5	1	3	5	4	-	9	7	-	36	
AN	<i>Pista bansei</i>	-	-	-	-	4	-	-	11	2	5	2	-	-	7	4	35	
AR	<i>Gammaropsis thompsoni</i>	21	-	5	-	-	-	3	-	2	1	1	-	-	1	-	35	
MO	<i>Macoma</i> sp	4	5	-	-	1	3	3	5	4	-	-	-	-	3	7	35	
PR	<i>Phoronis</i> sp	-	10	4	-	-	-	-	-	-	-	-	-	2	1	18	35	
AN	<i>Dispia uncinata</i>	-	2	16	-	4	3	1	2	-	-	1	-	-	1	4	34	
AR	<i>Ampelisca brachycladus</i>	-	-	-	-	-	33	-	1	-	-	-	-	-	-	-	34	
AR	<i>Campylaspis rubromaculata</i>	-	-	-	-	-	2	-	4	4	5	6	5	7	-	1	34	
AR	<i>Cylindroleberididae</i>	33	1	-	-	-	-	-	-	-	-	-	-	-	-	-	34	
AN	<i>Paleanotus bellis</i>	-	-	-	-	9	8	-	3	8	-	-	-	1	-	4	33	
MO	<i>Cumagia californica</i>	-	-	1	-	-	3	1	3	1	2	-	2	5	5	10	33	
AR	<i>Perotripus brevis</i>	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32	
MO	Aeolidiida	-	-	-	2	22	1	-	-	3	-	-	-	-	3	-	31	
PL	Platyhelminthes	11	5	-	2	1	-	1	1	7	-	-	-	3	-	-	31	
AN	Aphroditidae	29	1	-	-	-	-	-	-	-	-	-	-	-	-	-	30	
AN	<i>Chaetopterus vanoppedatus</i> Cmplx	1	-	-	2	-	1	-	2	15	-	8	1	-	-	-	30	
AN	<i>Typosyllis aciculata</i>	-	10	3	-	-	-	-	5	12	-	-	-	-	-	-	30	
AR	<i>Argissa hamatipes</i>	4	-	-	-	6	6	4	-	3	4	1	1	-	-	1	30	
BC	<i>Glottidia albida</i>	-	-	-	4	7	1	5	2	2	2	1	2	-	1	3	30	
MO	<i>Haminoea virescens</i>	-	-	-	-	7	-	-	5	17	-	-	-	1	-	-	30	
MO	<i>Macoma nasuta</i>	5	-	8	-	-	1	4	-	-	6	-	4	2	-	-	30	
AR	<i>Ammothaea hilgendorfi</i>	-	-	-	-	-	-	-	-	-	1	-	-	27	1	29		
AR	<i>Caecognathia crenulatifrons</i>	-	-	-	-	-	7	2	-	2	4	1	1	-	9	3	29	
MO	<i>Hiatella arctica</i>	-	-	-	-	2	-	1	-	22	3	1	-	-	-	-	29	
AN	<i>Exogone molesta</i>	-	-	-	-	-	-	12	2	14	-	-	-	-	-	-	28	
AR	<i>Aoroides spinosus</i>	-	-	-	-	-	27	-	-	-	-	-	-	-	1	-	28	
EC	Amphiuridae	-	-	-	-	-	3	1	2	6	5	1	3	5	-	2	28	
MO	<i>Rocheftoria grippi</i>	-	-	1	-	17	-	-	3	-	-	-	-	4	3	-	28	
AN	<i>Phylodocidae</i>	11	3	-	-	13	-	-	-	-	-	-	-	-	-	-	27	
AR	<i>Americhelidium rectipalmum</i>	-	-	-	1	-	-	-	2	7	9	2	1	-	3	2	27	
AR	<i>Anoropallene palpida</i>	15	-	-	-	-	-	-	1	-	6	3	1	-	-	-	27	
AN	<i>Malnugriella macginittiei</i>	-	-	-	-	-	1	-	5	-	-	-	-	-	12	8	26	
AN	<i>Pherusa neopapillata</i>	-	-	2	-	-	4	-	4	2	2	1	1	-	9	1	26	
AN	Pilargidae	-	-	-	-	26	-	-	-	-	-	-	-	-	-	-	26	
AR	Paguridae	4	-	1	-	6	11	-	3	1	-	-	-	-	-	-	26	
MO	<i>Crepidula</i> spp	-	4	1	-	1	20	-	-	-	-	-	-	-	-	-	26	
MO	<i>Mactrotoma californica</i>	22	1	-	-	-	-	-	-	1	-	-	-	-	2	-	26	
MO	<i>Mysella</i> sp	26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26	
NE	<i>Monostylifera</i> sp SD 1 Pt Loma 1995	-	-	-	-	-	-	-	-	-	-	-	-	7	19	-	26	
AN	<i>Aphelochaeta glandaria</i>	-	-	-	-	-	-	-	-	2	10	2	-	9	-	-	25	
AN	<i>Carazziella</i> sp A SCAMIT 1995	-	-	-	-	-	-	-	-	-	-	-	-	-	25	-	25	
CN	<i>Scolanthus</i> sp A SCAMIT 1983	-	-	-	1	11	-	-	7	-	1	1	-	-	3	1	25	
MO	<i>Sulcoretusa xystrum</i>	-	-	-	-	3	3	-	4	2	8	4	1	-	-	-	25	
AN	<i>Nereis latescens</i>	-	2	-	-	-	-	5	1	-	1	-	-	2	13	-	24	
AN	<i>Cirrophorus furcatus</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	22	-	23	
AN	<i>Exogone dwisula</i>	1	-	-	-	-	-	-	-	12	10	-	-	-	-	-	23	
AR	<i>Ampelisca egassizi</i>	-	1	7	-	-	2	-	1	11	1	-	-	-	-	-	23	
AR	<i>Photis macrotica</i>	-	19	4	-	-	-	-	-	-	-	-	-	-	-	-	23	
CN	Limnactiniidae sp A SCAMIT 1989	-	-	-	-	2	2	1	4	-	1	-	4	9	-	-	23	

**Appendix G-5. (Cont.).**

Phylum	Species	1972	1978	1980	1986	1988	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	Total
MO	<i>Bulla gouldiana</i>	1	-	1	-	-	3	-	-	4	-	1	9	-	3	1	23
MO	<i>Parvilucina tenuisculpta</i>	5	-	-	-	2	4	-	3	3	2	-	2	2	-	-	23
AN	<i>Chone minuta</i>	-	-	-	-	-	-	-	-	9	-	-	-	-	10	3	22
AN	<i>Sabellidae</i>	-	-	-	-	4	2	2	-	4	-	-	-	-	-	-	22
AN	<i>Sthenelanella uniformis</i>	-	-	-	-	2	4	-	4	-	-	-	4	6	2	-	22
AR	<i>Listriella diffusa</i>	-	1	-	-	3	-	-	-	-	4	1	-	1	12	-	22
AR	<i>Rhepoxyinius</i> sp	3	13	-	-	1	2	-	-	3	-	-	-	-	-	-	22
MO	<i>Alia carinata</i>	18	-	1	-	1	-	-	-	2	-	-	-	-	1	1	22
MO	<i>Kellia suborbicularis</i>	-	2	-	-	11	7	-	-	-	-	-	-	-	1	1	22
MO	<i>Philine bakeri</i>	-	-	-	-	2	-	-	3	2	11	-	4	-	-	-	22
MO	<i>Turbanilla santarosana</i>	-	-	-	-	-	-	-	-	1	7	4	1	-	7	2	22
AN	<i>Caulieriella</i> sp	-	-	-	-	20	-	-	-	-	-	-	1	-	-	-	21
AR	<i>Cancer antennarius</i>	-	15	-	-	-	3	1	-	1	1	-	-	-	-	-	21
AR	<i>Caprella californica</i>	-	-	-	-	-	-	-	-	7	1	-	-	2	6	5	21
AR	<i>Hemiproto</i> sp A Benedict 1978	-	-	-	-	-	-	-	3	2	3	3	10	-	-	-	21
AN	<i>Cirrophorus branchiatus</i>	-	-	-	-	-	2	-	-	5	-	-	13	-	-	-	20
AN	<i>Typosyllis hyalina</i>	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20
AR	<i>Caprella pilidigita</i>	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-	20
AR	<i>Lepidopa californica</i>	-	-	-	-	12	3	-	-	-	1	-	1	1	1	1	20
MO	<i>Actaecina culicella</i>	10	-	-	-	-	1	4	-	1	2	-	-	-	-	2	20
MO	<i>Lirularia acuticostata</i>	-	-	-	-	-	-	-	-	19	1	-	-	-	-	-	20
MO	<i>Mytilus</i> spp	1	-	1	-	-	14	4	-	-	-	-	-	-	-	-	20
AN	<i>Dipolydora socialis</i>	-	-	-	-	-	5	-	-	14	-	-	-	-	-	-	19
AN	<i>Eteone</i> spp	7	5	-	2	2	1	1	-	-	1	-	-	-	-	-	19
AN	<i>Polycirrus californicus</i>	-	-	-	1	-	2	-	-	1	-	-	-	5	10	19	
AR	<i>Campylaspis</i> sp C Myers & Benedict 1974	2	3	3	-	1	-	3	5	-	-	-	-	-	2	2	19
AR	<i>Listriella melanica</i>	1	-	-	-	4	-	1	4	1	1	-	1	-	2	4	19
AR	<i>Mesolamprops bispinosa</i>	6	-	-	-	-	-	-	-	-	-	-	13	-	-	-	19
EC	<i>Amphipolis squamata</i>	1	-	-	-	-	1	-	-	-	-	-	-	6	11	19	
NE	<i>Micrura alaskensis</i>	-	-	1	-	1	3	2	12	-	-	-	-	-	-	-	19
SI	<i>Thysanocardia nigra</i>	-	-	-	-	4	-	-	1	-	1	13	-	-	-	-	19
AN	<i>Diopatra ornata</i>	-	-	2	-	-	-	1	-	2	1	-	-	11	-	1	18
AN	<i>Euclymeninae</i>	-	-	-	-	4	8	3	3	-	-	-	-	-	-	-	18
AN	<i>Terebellidae</i>	3	-	-	-	8	-	-	2	5	-	-	-	-	-	-	18
AN	<i>Timarete luxuriosa</i>	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18
AR	<i>Foxiphalus golensis</i>	-	-	-	-	-	1	17	-	-	-	-	-	-	-	-	18
AR	<i>Paradexamine</i> sp SD1 Pt. Loma 1999	-	-	-	-	-	-	-	-	1	-	-	13	4	-	-	18
CN	<i>Edwardsiidae</i>	2	-	1	1	10	-	-	1	-	-	3	-	-	-	-	18
EC	<i>Amphiodia psara</i>	-	-	-	-	-	-	-	1	2	6	-	5	1	-	3	18
PL	<i>Stylochoplana longipenis</i>	-	-	-	-	3	3	5	-	4	-	1	-	1	1	-	18
AN	<i>Caulieriella bioculata</i>	-	-	-	-	-	-	1	-	-	-	-	-	16	-	17	
AN	<i>Diopatra splendidissima</i>	-	-	-	-	-	-	-	-	2	4	1	10	-	-	-	17
AR	<i>Blepharipoda occidentalis</i>	-	-	4	3	-	2	1	1	2	4	-	-	-	-	-	17
AR	<i>Postasterope barnesi</i>	-	-	-	-	-	4	3	5	2	1	-	-	-	2	-	17
AN	<i>Amaeana occidentalis</i>	2	-	-	-	-	-	-	-	1	1	-	2	1	8	1	16
AN	<i>Amphiteis scaphobranchiata</i>	1	-	-	-	-	-	-	-	3	2	1	4	3	2	-	16
AN	<i>Melinna oculata</i>	-	-	-	-	-	-	-	3	-	-	1	5	1	3	3	16
AR	<i>Desdimelita desdichada</i>	-	-	-	-	-	-	-	-	16	-	-	-	-	-	-	16
AR	<i>Podocerus brasiliensis</i>	7	-	-	-	-	-	-	-	-	-	-	-	3	5	1	16
MO	<i>Chione</i> sp	2	14	-	-	-	-	-	-	-	-	-	-	-	-	-	16
MO	<i>Crepidula naticarum</i>	-	-	6	-	1	-	-	-	-	4	3	2	-	-	-	16
MO	<i>Limaria hemphilli</i>	-	-	-	-	3	-	-	-	10	2	-	1	-	-	-	16
MO	<i>Melanochlamys diomedea</i>	-	-	1	-	4	-	1	2	2	1	2	-	-	3	-	16
MO	<i>Mysella</i> sp H SCAMIT 2001	-	-	9	-	-	3	-	-	-	-	-	-	-	4	-	16
MO	<i>Nassarius perpinguis</i>	3	-	3	-	-	-	2	5	-	1	1	1	-	-	-	16
AN	<i>Ampharetidae</i>	9	4	-	-	2	-	-	-	-	-	-	-	-	-	-	15
AN	<i>Eteone dilatata</i>	14	-	-	-	-	-	-	-	-	-	-	-	1	-	1	15
AN	<i>Glycinde armigera</i>	-	-	-	-	1	2	2	1	1	-	-	1	4	3	15	
AR	<i>Ampelisca cristata cristata</i>	7	-	-	-	-	3	4	1	-	-	-	-	-	-	-	15
AR	<i>Asteropella slatteryi</i>	-	-	-	-	-	-	-	-	2	1	2	4	1	2	3	15
AR	<i>Heteroserolis carinata</i>	-	-	-	-	-	-	-	-	-	6	3	1	2	3	-	15
AR	<i>Munnogonium tillerae</i>	1	-	-	-	-	-	1	3	-	4	1	5	-	-	-	15
AR	<i>Photis</i> sp OCI Diener 1992	-	-	-	-	-	-	-	-	-	-	-	7	5	3	15	
CN	<i>Epiactis prolifera</i>	-	-	-	-	15	-	-	-	-	-	-	-	-	-	-	15
SI	<i>Sipuncula</i>	-	5	-	-	1	2	1	2	-	-	-	-	-	2	2	15
AN	<i>Lumbrineris latreilli</i>	-	-	-	-	-	5	1	2	-	-	-	6	-	-	-	14
AN	<i>Polydora</i> sp	2	-	1	1	-	1	6	1	1	1	-	-	-	-	-	14
EC	<i>Strongylocentrotus purpuratus</i>	-	-	-	-	-	1	-	-	2	-	-	-	-	11	14	
AN	<i>Neosabellaria cementarium</i>	-	-	-	-	-	-	-	-	-	-	1	1	9	-	2	13
AN	<i>Nothria</i> sp	12	-	1	-	-	-	-	-	-	-	-	-	-	-	-	13
AN	<i>Onuphis eremita</i>	-	1	10	-	-	-	-	-	-	-	-	1	-	1	-	13
AN	<i>Ophryotrocha puerilis</i>	-	-	2	-	-	-	-	-	11	-	-	-	-	-	-	13
AN	<i>Spirorbis</i> sp	-	-	-	-	-	-	-	-	-	-	-	-	-	4	9	13
AR	<i>Aoroides</i> sp	-	-	-	-	-	3	1	1	3	3	-	-	-	-	2	13
AR	<i>Cyclaspis</i> sp C SCAMIT 1986	-	-	-	-	1	-	3	-	-	1	7	-	-	1	-	13
EC	<i>Ophiuroidea</i>	-	4	-	-	-	-	-	1	1	6	-	-	-	1	-	13
MO	<i>Diplodonta sericata</i>	-	-	-	-	-	-	2	1	8	2	-	-	-	-	-	13
MO	<i>Doto amyra</i>	-	-	-	-	13	-	-	-	-	-	-	-	-	-	-	13

Appendix G-5. (Cont.).

Phylum	Species	1972	1978	1980	1986	1988	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	Total
AN	<i>Monticellina siblinia</i>	-	-	-	-	-	6	-	6	-	-	-	-	-	-	-	12
AN	Onuphidae	6	-	-	-	-	2	1	1	-	-	1	-	-	1	1	12
AN	<i>Poecilochaetus johnsoni</i>	-	-	-	-	3	1	-	5	-	-	2	1	-	-	-	12
AN	<i>Polydora nuchalis</i>	6	-	-	-	-	-	-	-	-	-	4	-	2	-	-	12
AN	<i>Syllis (Ehlersia) heterochaeta</i>	-	-	-	-	5	-	-	-	-	-	-	-	1	6	6	12
AN	<i>Syllis (Typosyllis) sp</i>	-	-	-	-	-	-	-	-	-	-	1	-	-	11	11	12
AR	<i>Cerapus tubularis</i> Cmplx	-	-	-	-	-	-	-	-	5	1	1	1	2	1	1	12
AR	<i>Nasageneia quinsana</i>	-	-	-	-	-	-	-	-	7	-	-	-	2	3	-	12
AR	<i>Pinnixa</i> sp	1	2	2	1	1	1	-	2	1	1	-	-	-	-	-	12
EC	<i>Amphiodia urtica</i>	1	-	-	-	1	-	-	4	5	-	1	-	-	-	-	12
MO	<i>Eulithidium substriatum</i>	-	-	-	-	-	2	-	-	6	-	4	-	-	-	-	12
MO	<i>Tellina</i> sp	11	1	-	-	-	-	-	-	-	-	-	-	-	-	-	12
AN	<i>Decamastus gracilis</i>	-	-	-	-	-	-	5	6	-	-	-	-	-	-	-	11
AN	<i>Dipolydora bidentata</i>	-	-	-	-	-	1	-	10	-	-	-	-	-	-	-	11
AN	<i>Goniada brunnea</i>	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
AN	<i>Nephrys californiensis</i>	7	2	1	1	-	-	-	-	-	-	-	-	-	-	-	11
AN	<i>Onuphis eremita parva</i>	-	-	-	1	-	-	-	2	1	4	1	-	2	-	-	11
AR	<i>Balanus pacificus</i>	-	2	3	-	-	-	1	-	1	-	-	-	1	1	2	11
AR	<i>Cthamalus</i> sp	-	-	8	-	-	3	-	-	-	-	-	-	-	-	-	11
MO	<i>Leporimetis obesa</i>	3	-	-	-	-	-	-	-	1	-	-	-	2	3	2	11
MO	<i>Petricola hertziana</i>	-	2	-	-	-	6	-	3	-	-	-	-	-	-	-	11
MO	<i>Polygireulima rutila</i>	-	-	-	-	-	1	-	2	-	2	2	2	-	-	-	11
AN	<i>Cirriformia spirabranchia</i>	1	-	-	-	-	-	-	-	-	-	-	3	6	-	-	10
AN	<i>Naineris dendritica</i>	-	-	-	-	-	-	-	-	-	1	-	3	2	2	2	10
AR	<i>Aerooides intermedius</i>	-	-	-	-	-	-	1	-	-	9	-	-	-	-	-	10
AR	<i>Cancer</i> sp	3	1	1	-	-	-	2	-	-	-	2	-	-	-	1	10
AR	<i>Exosphaeroma rhomburum</i>	-	-	-	1	-	-	2	-	-	1	1	-	2	3	-	10
AR	<i>Ianiropsis tridens</i>	1	-	-	-	-	-	-	-	9	-	-	-	-	-	-	10
AR	<i>Leptocuma forsmanni</i>	2	-	-	-	3	-	-	-	-	-	-	1	3	1	-	10
AR	<i>Lophopanopeus bellus</i>	-	-	-	-	2	5	-	-	3	-	-	-	-	-	-	10
AR	<i>Metamysidopsis elongata</i>	-	-	-	-	1	-	1	-	1	1	3	-	1	2	-	10
CN	Hydrozoa	-	4	1	3	-	-	1	-	-	-	1	-	1	-	-	10
MO	<i>Amphithalamus tenuis</i>	-	-	-	-	-	-	-	-	-	-	1	-	1	8	-	10
MO	<i>Balcis oldroydae</i>	-	2	-	-	1	-	1	-	-	3	-	1	-	1	1	10
MO	<i>Petricola carditoides</i>	-	-	2	1	-	-	-	2	-	-	-	1	-	4	-	10
MO	<i>Rictaxis punctocaelatus</i>	-	-	-	-	-	-	-	-	-	2	-	2	7	-	1	10
AN	<i>Caulieriella pacifica</i>	-	-	-	-	-	-	-	-	-	-	5	-	4	-	-	9
AN	<i>Euchone limnicola</i>	-	-	-	1	-	1	-	-	-	-	-	3	4	-	-	9
AN	<i>Malmgreniella</i> spp	-	-	-	-	-	1	-	5	-	-	3	-	-	-	-	9
AN	<i>Sabellaria gracilis</i>	-	-	-	-	-	-	-	-	1	-	4	3	1	-	-	9
AN	<i>Scoletoma</i> sp C Harris 1985	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9
AN	Spionidae	2	2	-	-	-	1	-	-	-	-	-	4	-	-	-	9
AR	Calanoida	-	3	6	-	-	-	-	-	-	-	-	-	-	-	-	9
AR	<i>Gnathopleustes serratus</i>	4	-	-	-	2	3	-	-	-	-	-	-	-	-	-	9
AR	<i>Incisocalliope newportensis</i>	4	-	-	-	2	3	-	-	-	-	-	-	-	-	-	9
AR	<i>Lophopanopeus leucomanus</i>	-	-	-	1	-	4	-	-	4	-	-	-	-	-	-	9
EC	Astrocoidea	2	-	-	-	1	-	-	-	4	2	-	-	-	-	-	9
MO	<i>Caecum</i> sp	2	-	-	-	-	1	-	-	6	-	-	-	-	-	-	9
NE	<i>Zygonemertes virescens</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	3
AN	<i>Ancistrosyllis hamata</i>	2	-	1	-	1	-	-	1	1	-	1	-	-	1	-	8
AN	<i>Aricidea (Acmira) horikoshii</i>	-	3	-	1	-	-	1	-	-	-	2	-	-	1	1	8
AN	<i>Nephys</i> sp	5	1	1	-	-	-	1	-	-	-	-	-	-	-	-	8
AN	<i>Polycirus</i> spp	-	-	-	4	1	-	-	2	1	-	-	-	-	-	-	8
AN	<i>Polydora limicola</i>	-	-	-	-	-	1	-	-	-	7	-	-	-	-	-	8
AN	Polynoidae	-	-	-	-	1	7	-	-	-	-	-	-	-	-	-	8
AN	<i>Sphaerosyllis pirifera</i>	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
AR	<i>Caprella equilibra</i>	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	8
AR	<i>Cyclaspis nubila</i>	1	2	-	-	-	-	1	-	-	4	1	-	-	-	-	8
AR	<i>Leuroleberis sharpei</i>	-	-	-	-	-	1	1	1	-	1	1	-	-	1	2	8
AR	<i>Pagurus redondoensis</i>	-	-	-	-	-	-	-	-	7	-	-	-	-	1	-	8
AR	<i>Paracerceis</i> sp	3	-	-	-	-	-	-	-	1	-	2	-	-	2	-	8
AR	<i>Pinnixa forficulimanus</i>	-	-	-	-	-	2	-	1	1	1	-	1	1	1	1	8
AR	<i>Pinnixa franciscana</i>	-	-	-	-	1	2	2	-	-	-	-	-	-	1	2	8
AR	<i>Poecilostomatoidea</i>	5	-	-	-	-	-	-	-	-	-	-	-	-	-	3	8
CN	<i>Euphypha</i> sp A Hochberg & Ljubenkov 1998	-	-	-	-	1	-	1	1	1	1	-	4	-	-	-	8
EC	<i>Astropecten</i> sp	-	-	-	-	-	-	-	2	5	1	-	-	-	-	-	8
MO	<i>Actaecina</i> sp	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
MO	Gastropoda	1	-	-	-	-	1	2	-	3	-	-	1	-	-	-	8
MO	<i>Nassarius mendicus</i>	3	-	3	-	-	2	-	-	-	-	-	-	-	-	-	8
MO	Nudibranchia	8	-	-	-	-	-	-	-	-	-	-	8	-	-	-	8
MO	<i>Rhamphidonta retifera</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
MO	<i>Solen columbianum</i>	-	-	-	-	-	1	-	-	1	-	-	-	1	5	-	8
MO	<i>Solen sicarius</i>	-	-	-	-	-	-	-	-	2	1	-	1	2	1	1	8
MO	<i>Tellina</i> sp B SCAMIT 1995	-	-	-	-	-	-	-	2	-	-	-	-	-	5	1	8
NE	<i>Carinomella lactea</i>	-	-	8	-	-	-	-	-	1	7	-	-	-	-	-	8
PL	<i>Pseudoceros</i> sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
AN	Autolytinae	-	-	-	-	1	-	-	-	-	-	-	-	-	-	6	7
AN	<i>Brania heterocirra</i>	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	7

Appendix G-5. (Cont.).

Phylum	Species	1972	1978	1980	1986	1988	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	Total
AN	<i>Cirriformia</i> sp	6	-	-	-	-	-	1	-	-	-	-	-	-	-	-	7
AN	<i>Exogone breviseta</i>	-	-	-	-	-	-	-	-	-	5	-	2	-	-	-	7
AN	<i>Lysippe</i> sp A Williams 1985	-	-	-	-	-	-	4	-	-	-	1	-	1	1	-	7
AN	<i>Onuphis elegans</i>	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
AN	<i>Pionosyllis gigantea</i>	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
AR	<i>Aroides secundus</i>	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	7
AR	<i>Macrocyprina pacifica</i>	-	-	-	-	-	1	-	2	1	-	1	-	-	2	-	7
AR	<i>Photis conchicola</i>	3	-	3	1	-	-	-	-	-	-	-	-	-	-	-	7
AR	<i>Poecilostomatoidea</i> sp A MBC 1996	-	-	-	-	-	-	4	-	-	-	-	-	2	1	-	7
AR	<i>Pyromaeia tuberculata</i>	-	-	-	-	-	2	-	-	-	-	2	-	3	-	-	7
MO	<i>Calyptraea contorta</i>	-	-	-	-	-	7	-	-	-	-	-	-	-	-	-	7
MO	<i>Hermissenda crassicornis</i>	-	-	3	1	-	-	-	-	-	3	-	-	-	-	-	7
MO	<i>Mytilus galloprovincialis</i>	-	-	3	-	-	-	-	-	3	-	1	-	-	-	-	7
MO	<i>Nassarius fossatus</i>	-	-	-	-	-	4	-	-	-	-	-	-	3	-	-	7
MO	<i>Tagelus</i> sp	3	-	-	-	-	-	4	-	-	-	-	-	-	-	-	7
MO	<i>Turbanilla</i> sp	4	-	1	-	-	1	1	-	-	-	-	-	-	-	-	7
NE	<i>Micrura</i> sp	-	-	-	-	6	-	-	-	-	-	-	-	1	-	-	7
NE	<i>Tubulanus nothus</i>	-	-	-	-	-	-	-	-	-	1	2	1	-	1	2	7
AN	<i>Fabricinuda limnicola</i>	-	-	-	-	-	1	-	-	-	5	-	-	-	-	-	6
AN	<i>Jasmineira</i> sp B SCAMIT 1986	-	-	-	-	-	1	-	-	-	3	1	1	1	-	-	6
AN	<i>Lumbrineris zonata</i>	-	5	1	-	-	-	-	-	-	-	-	-	-	-	-	6
AN	<i>Microspio microcera</i>	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	6
AN	<i>Ophelia assimilis</i>	-	-	-	-	2	1	-	3	-	-	-	-	-	-	-	6
AN	<i>Paraonella platybranchia</i>	1	-	-	-	-	1	-	-	-	-	-	-	4	-	-	6
AN	<i>Polycirrus</i> sp A SCAMIT 1995	-	-	-	-	-	-	-	-	-	-	1	2	-	3	-	6
AN	<i>Scoletoma</i> sp	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	6
AN	<i>Sthenelais verruculosa</i>	-	-	-	-	-	1	-	-	-	-	-	3	2	-	-	6
AR	<i>Apolochus barnardi</i>	-	-	-	-	-	-	-	-	1	-	-	3	-	-	2	6
AR	<i>Berllos macromanus</i>	-	-	-	-	-	-	-	-	5	-	-	-	1	-	-	6
AR	<i>Brachyura</i>	-	1	1	-	-	2	-	-	1	1	-	-	-	-	-	6
AR	<i>Caprella</i> sp	5	-	-	-	-	1	-	-	-	-	2	3	-	-	1	6
AR	<i>Claudidium vancouverense</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
AR	<i>Leticorophium baconi</i>	-	-	1	-	-	-	-	-	4	-	-	-	1	-	-	6
AR	<i>Pinnixa longipes</i>	-	-	-	-	-	-	-	-	3	2	-	-	-	-	-	6
AR	<i>Rhepoxynius variatus</i>	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	6
AR	<i>Tiburonella viscana</i>	-	-	-	-	-	2	-	2	-	-	-	-	1	1	-	6
CO	<i>Agnezia septentrionalis</i>	-	-	-	-	-	-	-	1	-	1	-	4	-	-	-	6
MO	<i>Cyclostremella dalli</i>	-	-	1	-	-	3	-	-	-	-	-	1	-	1	-	6
MO	<i>Iurusella lamellifera</i>	-	-	-	-	-	-	-	1	-	-	4	-	-	-	1	6
AN	<i>Chone albocincta</i>	-	-	-	-	-	-	-	-	1	-	4	-	-	-	-	5
AN	<i>Chone</i> sp	-	4	1	-	-	-	-	-	-	1	-	3	-	-	-	5
AN	<i>Morphysa</i> sp A Harris & Velarde 1983	-	-	-	-	-	-	-	-	-	1	-	3	-	1	-	5
AN	<i>Ophelia pulchella</i>	-	-	-	-	-	-	-	1	-	-	-	1	3	-	-	5
AN	<i>Phyllochaetopterus prolifica</i>	-	-	-	-	3	-	-	-	-	-	1	1	-	-	-	5
AN	<i>Sabellariidae</i>	1	1	-	-	3	-	-	-	-	-	-	-	-	-	-	5
AN	<i>Scolelepis occidentalis</i>	-	-	-	-	-	-	-	4	-	1	-	-	-	-	-	5
AN	<i>Sphaerephesia similisetis</i>	-	-	-	-	-	-	-	-	3	-	-	-	2	-	-	5
AR	<i>Ampelisca</i> sp	2	-	-	-	-	1	2	-	-	-	-	-	-	-	-	5
AR	<i>Balanus</i> sp	-	-	-	-	3	-	-	2	-	-	-	-	-	-	-	5
AR	<i>Campylaspis hartae</i>	2	-	-	-	-	-	1	-	-	1	-	1	-	-	-	5
AR	<i>Euphilomedes longiseta</i>	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
AR	<i>Myicola</i> sp	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
AR	<i>Phoxocephalidae</i>	-	-	1	-	3	-	1	-	-	-	-	-	-	-	-	5
AR	<i>Rhepoxynius</i> sp A SCAMIT 1987	-	-	-	-	2	-	-	-	-	-	-	-	1	1	1	5
AR	<i>Rocinela belliceps</i>	-	-	-	-	-	-	-	-	-	-	2	-	1	1	1	5
AR	<i>Scleroplaex granulata</i>	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	5
AR	<i>Tritella laevis</i>	4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	5
EC	<i>Amphiodia</i> sp	-	-	-	-	-	-	-	5	-	1	1	-	2	-	1	5
EC	<i>Amphiura arcystala</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
EC	<i>Lytechinus pictus</i>	-	-	-	-	-	-	-	-	-	1	4	-	-	-	-	5
EC	<i>Ophiactis simplex</i>	-	-	2	-	-	-	-	-	-	1	2	-	-	-	-	5
MO	<i>Assiminea californica</i>	-	-	-	-	-	-	-	-	-	-	1	3	-	-	1	5
MO	<i>Asthenothaerus diegensis</i>	-	-	1	-	-	-	-	1	-	-	-	-	3	-	-	5
MO	<i>Crepidula onyx</i>	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
MO	<i>Dendrochiton gothicus</i>	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	5
MO	<i>Eubranchidae</i>	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	5
MO	<i>Lyonsia californica</i>	-	1	1	-	-	-	-	-	-	1	-	1	1	-	-	5
MO	<i>Macoma indentata</i>	-	-	-	1	1	-	-	-	-	3	-	-	-	-	-	5
MO	<i>Turbanilla kelseyi</i>	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
MO	<i>Veneridae</i>	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	5
NE	<i>Amphiporus imparispinosus</i>	-	-	-	-	-	-	-	-	-	3	-	-	2	-	2	5
AN	<i>Brania californiensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
AN	<i>Capitellidae</i>	-	-	-	3	-	-	1	-	-	4	-	-	-	-	-	4
AN	<i>Chaetozone</i> spp	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	4
AN	<i>Chloëia pinnata</i>	-	-	-	-	-	2	-	-	-	1	-	1	-	-	-	4
AN	<i>Clymenella</i> sp A Harris 1985	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	4
AN	<i>Cossura</i> sp A Phillips 1987	-	-	-	-	-	-	-	-	-	-	-	3	-	1	-	4
AN	<i>Ctenodrilus serratus</i>	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	4

Appendix G-5. (Cont.).

Phylum	Species	1972	1978	1980	1986	1988	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	Total
AN	<i>Eteone fauchaldi</i>	-	-	-	-	1	1	1	-	-	-	-	-	1	-	-	4
AN	<i>Eulalia californiensis</i>	-	1	1	-	-	2	-	-	-	-	-	-	-	-	-	4
AN	<i>Halosydnida brevisetosa</i>	-	-	-	-	-	3	-	-	-	-	-	-	-	1	-	4
AN	<i>Hemipodus borealis</i>	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	4
AN	<i>Hydroides gracilis</i>	-	-	-	1	1	-	-	-	-	-	-	-	-	2	-	4
AN	<i>Hydroides uncinatus</i>	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	4
AN	<i>Lumbrinerides platypygos</i>	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	4
AN	<i>Nephtys simoni</i>	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	4
AN	<i>Nereidae</i>	2	-	-	-	1	-	-	-	1	-	-	-	-	-	-	4
AN	<i>Nereis</i> sp	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	4
AN	<i>Notomastus lineatus</i>	-	-	1	-	-	-	-	-	3	-	-	-	-	-	-	4
AN	<i>Odontosyllis phosphorea</i>	-	-	-	1	-	-	-	-	-	-	-	-	2	1	-	4
AN	<i>Onuphis</i> sp 1 of Pt. Loma 1983	-	-	-	-	-	-	-	1	1	1	-	-	1	-	-	4
AN	<i>Ophyrotrocha</i> sp	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	4
AN	<i>Pista agassizi</i>	-	-	-	-	-	1	-	-	1	1	-	-	1	-	-	4
AN	<i>Pista</i> sp	-	-	-	-	-	1	-	-	3	-	-	-	-	-	-	4
AN	<i>Polychaeta</i>	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	4
AN	<i>Polydora websteri</i>	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	4
AN	<i>Pseudopolydora kempfi</i>	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	4
AN	<i>Scolelepis tridentata</i>	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	4
AN	<i>Streblosoma</i> sp B SCAMIT 1985	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	4
AR	<i>Ampithoe</i> sp	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	4
AR	<i>Copepoda</i>	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
AR	<i>Crangon alaskensis</i>	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	4
AR	<i>Cumacea</i>	-	-	-	-	-	-	2	-	2	-	-	-	-	-	-	4
AR	<i>Cypridoidea</i>	-	-	-	1	-	-	-	-	-	-	-	-	3	-	-	4
AR	<i>Foxiphilus obtusidens</i>	-	-	-	-	-	-	-	-	3	-	-	-	1	-	-	4
AR	<i>Heterocrypta occidentalis</i>	-	-	-	-	-	1	-	1	1	-	-	-	-	-	-	4
AR	<i>Hippolytidae</i>	-	-	-	-	1	2	-	-	-	-	-	-	1	-	-	4
AR	<i>Majidae</i>	-	-	1	-	-	1	-	1	1	-	-	-	-	-	-	4
AR	<i>Mysidopsis intii</i>	-	-	-	-	1	-	-	1	1	-	-	-	-	-	-	4
AR	<i>Peramphithoe tea</i>	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	4
AR	<i>Pinnotheridae</i>	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	4
AR	<i>Podocerus</i> sp	-	-	-	-	1	2	-	-	1	-	-	-	-	-	-	4
AR	<i>Pugettia</i> sp	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
AR	<i>Rutiderma rostratum</i>	-	-	-	-	1	1	1	-	-	-	-	-	-	1	-	4
AR	<i>Tanystylum californicum</i>	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	4
CN	<i>Pennatulacea</i>	-	-	-	-	-	-	-	-	-	1	-	-	1	2	4	
EC	<i>Chiridota</i> sp	2	-	-	-	-	-	-	2	-	-	-	-	-	-	-	4
MO	<i>Barleeria halotiphila</i>	1	-	1	-	-	-	-	-	-	-	-	-	-	2	-	4
MO	<i>Collisella ochracea</i>	-	-	-	-	-	-	-	-	-	1	-	-	1	2	4	
MO	<i>Crepidula perforans</i>	-	-	3	-	-	-	-	-	1	-	-	-	-	-	-	4
MO	<i>Ensis myrae</i>	-	-	-	-	-	-	-	-	1	2	-	-	1	-	-	4
MO	<i>Eulithidium pulloides</i>	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	4
MO	<i>Lithophaga plumula</i>	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	4
MO	<i>Macoma secta</i>	-	-	-	-	-	-	-	-	-	-	-	2	-	2	-	4
MO	<i>Modiolus capax</i>	-	1	3	-	-	-	-	-	-	-	-	-	-	-	-	4
MO	<i>Nassarius</i> sp	2	-	-	-	-	-	2	-	-	-	-	1	1	-	-	4
MO	<i>Petricola californiensis</i>	2	-	-	-	-	-	-	-	-	1	1	-	-	-	-	4
MO	<i>Solen rostiformis</i>	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
MO	<i>Sphaeria lenticula</i>	-	-	-	-	-	2	-	-	-	-	-	-	-	2	-	4
MO	<i>Tegula aureoincta</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	4
MO	<i>Tryonia imitator</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	3	-	4
MO	<i>Turbonilla</i> sp F MBC 1971	-	-	-	-	1	-	-	-	-	1	-	-	-	2	-	4
NE	<i>Zygonemertes</i> sp	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	4
AN	<i>Ancistrosyllis groenlandica</i>	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-	3
AN	<i>Aricidea</i> ( <i>Aricidea</i> ) <i>wassi</i>	-	-	-	-	-	1	-	-	1	-	-	-	1	-	-	3
AN	<i>Chaetozone armata</i>	-	-	-	-	-	-	-	-	1	-	-	-	2	-	-	3
AN	<i>Chone</i> sp SD 1 Pt. Loma 1997	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	3
AN	<i>Eteone californica</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1	3
AN	<i>Glycynide polygnatha</i>	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
AN	<i>Hydroides</i> sp	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
AN	<i>Lumbrineridae</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	3
AN	<i>Magelona californica</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	3
AN	<i>Magelona</i> sp	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
AN	<i>Malmgreniella scriptoria</i>	-	-	-	-	2	1	-	-	-	-	-	-	-	-	-	3
AN	<i>Naineris</i> sp	-	1	-	-	-	2	-	-	-	-	-	-	-	-	-	3
AN	<i>Nereiphylla castanea</i>	-	-	-	-	-	-	-	-	-	1	-	-	-	2	-	3
AN	<i>Poecilochaetus</i> sp A Martin 1977	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	3
AN	<i>Polydora cornuta</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	3
AN	<i>Scoletoma</i> sp B Harris 1985	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3
AN	<i>Sige</i> sp A of SCAMIT	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
AN	<i>Syllides</i> sp	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	3
AN	<i>Syllis</i> ( <i>Ehlersia</i> ) sp	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	3
AN	<i>Syllis</i> ( <i>Syllis</i> ) <i>gracilis</i>	-	-	-	-	-	-	-	1	1	-	-	-	-	1	-	3
AR	<i>Anoplodactylus nodosus</i>	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	3
AR	<i>Aoroides</i> sp A SCAMIT 1996	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3
AR	<i>Cyclaspis</i> sp B SCAMIT 1989	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3

Appendix G-5. (Cont.).

Phylum	Species	1972	1978	1980	1986	1988	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	Total
AR	<i>Dellocerus planus</i>	-	-	-	-	-	1	-	2	-	-	-	-	-	-	-	3
AR	<i>Ischyrocerus pelagops</i>	-	-	-	-	-	-	-	-	2	-	-	1	-	-	-	3
AR	<i>Listriella goleta</i>	-	-	-	-	1	1	-	-	1	-	-	-	-	-	-	3
AR	<i>Melita</i> sp	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	3
AR	<i>Metatiron tropakis</i>	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	3
AR	<i>Mysidacea</i>	1	-	-	-	1	-	1	-	-	-	-	-	-	-	-	3
AR	<i>Paguristes ulreyi</i>	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	3
AR	<i>Paracerceis sculpta</i>	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
AR	<i>Photis lacia</i>	-	-	-	-	-	1	-	-	-	-	-	2	-	-	-	3
AR	<i>Phoxichiliidium parvum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	3
AR	<i>Pontogeneia rostrata</i>	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	3
AR	<i>Randallia ornata</i>	-	-	-	-	1	-	-	-	2	-	-	-	-	-	-	3
AR	<i>Rutiderma judayi</i>	-	-	-	-	1	-	-	-	-	-	-	-	-	2	-	3
AR	<i>Tanaidacea</i>	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO	<i>Clevelandia ios</i>	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
EC	<i>Astropecten armatus</i>	-	1	1	-	-	-	-	-	-	-	-	-	-	-	1	3
EP	<i>Bowerbankia gracilis</i>	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3
EP	<i>Ectoprocta</i>	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3
MO	<i>Acmaea rosacea</i>	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	3
MO	<i>Adula diegensis</i>	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	3
MO	<i>Cadulus aberrans</i>	-	-	-	-	-	-	-	1	-	2	-	-	-	-	-	3
MO	<i>Collisella pelta</i>	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	3
MO	<i>Compsomyax subdiaphana</i>	1	-	-	-	-	-	2	-	-	-	-	-	-	-	-	3
MO	<i>Cryptomya californica</i>	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	3
MO	<i>Cylichna diegensis</i>	-	-	-	-	-	2	-	-	-	-	1	-	-	-	-	3
MO	<i>Epilucina californica</i>	-	-	-	-	1	-	-	-	-	-	-	1	1	-	-	3
MO	<i>Lucinisca nuttalli</i>	-	-	1	-	-	-	-	-	-	1	-	1	-	-	-	3
MO	<i>Neverita reclusiana</i>	-	1	-	-	-	1	1	-	-	-	-	-	-	-	-	3
MO	<i>Ocinebrina</i> sp	-	-	-	-	2	-	-	1	-	-	-	-	-	-	-	3
MO	<i>Odostomia eugena</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3
MO	<i>Tegula eiseni</i>	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	3
NE	<i>Amphiporus cruentatus</i>	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3
NE	Hoplonemertea sp A Paquette 1988	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
NE	Hoplonemertea sp B MEC 1988	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3
NE	Hoplonemertea sp C Paquette 1999	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3
NE	<i>Tubulanus cingulatus</i>	-	-	-	-	-	1	-	-	-	-	1	-	1	-	-	3
NE	<i>Tubulanus frenatus</i>	-	-	-	-	-	-	1	1	-	-	-	-	-	1	-	3
PL	<i>Notoplana</i> sp	-	-	1	-	-	-	-	-	1	-	-	1	-	-	-	3
AN	<i>Chone</i> sp C of Harris 1984	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2
AN	<i>Diopatra</i> sp	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2
AN	<i>Diopatra tridentata</i>	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2
AN	Dorvilleidae	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
AN	<i>Eteone leptotes</i>	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	2
AN	<i>Eteone pacifica</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2
AN	<i>Eurythoe complanata</i>	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	2
AN	<i>Eusyllis</i> sp	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2
AN	<i>Exogone</i> sp	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	2
AN	<i>Goniada maculata</i>	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	2
AN	<i>Goniada</i> sp	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
AN	<i>Halosydna johnsoni</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	2
AN	<i>Harmothoe</i> sp	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	2
AN	<i>Heteromastus filiformis</i>	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	2
AN	<i>Hydroides pacificus</i>	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	2
AN	<i>Laonice cirrata</i>	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	2
AN	<i>Lumbrineris pallida</i>	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
AN	Malmgreniella sp A SCAMIT 1997	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
AN	<i>Megalomma pigmentum</i>	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	2
AN	<i>Notomastus latericeus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2
AN	<i>Onuphis iridescens</i>	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
AN	Paraonidae	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	2
AN	<i>Phyllocoete groenlandica</i>	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	2
AN	<i>Prionospio multibranchiata</i>	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	2
AN	<i>Prionospio</i> sp	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	2
AN	<i>Sphaerodoropsis</i> sp	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2
AN	<i>Sphaerodoropsis sphaerulifer</i>	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	2
AN	<i>Sphaerosyllis ranunculus</i>	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	2
AN	<i>Spiophanes berkeleyorum</i>	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	2
AN	<i>Spiophanes</i> sp	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
AR	<i>Alpheus californiensis</i>	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	2
AR	<i>Alpheus</i> sp	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	2
AR	<i>Anoplodactylus</i> sp	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	2
AR	<i>Anoplodactylus viridintestinalis</i>	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2
AR	<i>Atylus tridens</i>	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	2
AR	<i>Cancer gracilis</i>	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	2
AR	Corophiidae	-	-	-	-	-	-	2	-	-	-	-	1	-	-	-	2
AR	Cyclopoida	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	2
AR	<i>Cyprinotus californicus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
AR	<i>Cythereis</i> sp	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2

Appendix G-5. (Cont.).

Phylum	Species	1972	1978	1980	1986	1988	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	Total
AR	Decapoda	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
AR	<i>Euphilomedes carcharodonta</i>	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	2
AR	<i>Grandidierella japonica</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2
AR	Halecaridae	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2
AR	<i>Lepidepecreum serraculum</i>	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	2
AR	<i>Listriella eriopispa</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2
AR	<i>Loxorhynchus</i> sp	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	2
AR	<i>Melita sulca</i>	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	2
AR	<i>Neastacilla californica</i>	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2
AR	<i>Pachynus barnardi</i>	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	2
AR	<i>Paguristes</i> sp	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
AR	<i>Photis californica</i>	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	2
AR	<i>Rhepoxynius heterocuspisatus</i>	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	2
AR	<i>Stenothoe estacula</i>	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	2
AR	<i>Stenothoe</i> sp	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	2
AR	Stenothoidae	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
CN	Ceriantharia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
CN	<i>Renilla kolikeri</i>	-	-	1	-	-	1	-	-	1	-	1	-	-	-	-	2
CN	<i>Stylatula elongata</i>	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	2
CN	<i>Syncoryne eximia</i>	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	2
EC	<i>Eupentacta</i> sp	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
EC	<i>Lovenia cordiformis</i>	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	2
EC	<i>Ophioctis savignyi</i>	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2
EP	<i>Antropora tincta</i>	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	2
EP	<i>Celleporaria brunnea</i>	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2
MO	Aclididae	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	2
MO	<i>Aeolidla papillosa</i>	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2
MO	<i>Alia tuberosa</i>	-	-	-	-	2	-	-	-	2	-	-	-	-	-	-	2
MO	<i>Astynis aurantiaca</i>	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
MO	<i>Crepidula glottidianum</i>	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	2
MO	<i>Crepidula norrisiarum</i>	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	2
MO	<i>Dendrochiton thomporus</i>	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	2
MO	<i>Epitonium bellastriatum</i>	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	2
MO	<i>Epitonium sawinae</i>	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	2
MO	<i>Halistylus pupoideus</i>	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	2
MO	<i>Kurtziella plumbea</i>	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	2
MO	<i>Lirularia parcipicta</i>	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2
MO	Muricidae	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2
MO	<i>Musculista senhousia</i>	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	2
MO	<i>Odostomia helga</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
MO	<i>Odostomia nr. pharcida</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2
MO	<i>Odostomia</i> sp	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	2
MO	<i>Odostomia</i> sp D MBC 1980	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	2
MO	<i>Petricola</i> sp	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	2
MO	<i>Philine</i> sp A of SCAMIT 1988	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	2
MO	<i>Thracia</i> sp	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	2
MO	<i>Turbanilla heterolopha</i>	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	2
MO	<i>Turbanilla</i> sp A SCAMIT 1988	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2
MO	<i>Volvellula cylindrica</i>	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2
NE	<i>Amphiporus</i> sp	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	2
NE	<i>Prosonochirus albidus</i>	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2
NE	<i>Tetrasetmma nigritrons</i>	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2
PL	<i>Cryptocelis occidentalis</i>	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	2
PO	Porifera	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	2
PR	<i>Phoronopsis</i> sp	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2
AN	<i>Apostobranchus ornatus</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
AN	<i>Arenicola brasiliensis</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
AN	<i>Aricidea</i> sp	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
AN	<i>Asclerocheilus californicus</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
AN	<i>Boccardiella hamata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
AN	<i>Chaetozone columbiana</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
AN	<i>Cirratulus cirratus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
AN	<i>Eteone pigmentata</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
AN	Eunicidae	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
AN	<i>Eupolymnia heterobranchia</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
AN	<i>Eusyllis transecta</i>	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
AN	<i>Exogone uniformis</i>	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
AN	<i>Flabelliderma essenbergae</i>	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
AN	Flabelligeridae	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
AN	Glyceridae	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
AN	<i>Glycinde</i> sp	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
AN	<i>Halosydna latior</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
AN	<i>Haplosyllis spongicola</i>	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
AN	<i>Harmothoe hirsuta</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
AN	<i>Lanice conchiloga</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
AN	<i>Levinsernia oculata</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
AN	<i>Loimia</i> sp A SCAMIT 2001	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
AN	<i>Malacoboceros indicus</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1

**Appendix G-5. (Cont.).**

Phylum	Species	1972	1978	1980	1986	1988	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	Total
AN	<i>Naineris uncinata</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
AN	<i>Neanthes succinea</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
AN	<i>Nephrys ferruginea</i>	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
AN	<i>Nereis mediator</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
AN	<i>Odontosyllis</i> sp	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
AN	Oenonidae	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-	1
AN	<i>Onuphis</i> sp	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
AN	Opheliidae	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
AN	<i>Opisthodonta</i> sp B Uebelacker 1984	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
AN	<i>Pherusa capulata</i>	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
AN	<i>Phloe glabra</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
AN	<i>Phragmatopoma californica</i>	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
AN	<i>Podarkeopsis</i> sp A Velarde & Harris 1987	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
AN	<i>Scalibregma californicum</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	
AN	<i>Scolelepis</i> spp	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
AN	<i>Scoletoma</i> sp A Harris 1985	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
AN	<i>Scoloplos</i> sp	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
AN	<i>Sigambla tentaculata</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
AN	Sphaerodorididae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
AN	<i>Sthenelais tertia</i> <i>glabra</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
AN	<i>Sthenolepis fimbriarum</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
AN	<i>Syllis</i> ( <i>Ehlersia</i> ) <i>hyperion</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
AN	<i>Syllis</i> ( <i>Syllis</i> ) <i>elongata</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
AN	<i>Thomora johnstoni</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
AN	Tubificidae	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
AN	<i>Typosyllis alternata</i>	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
AN	<i>Typosyllis fasciata</i>	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
AR	Aeginellidae	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
AR	<i>Alpheus bellimanus</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
AR	Ammotheidae	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
AR	<i>Ampelisca brevisimulata</i>	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
AR	<i>Ampelisca careyi</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
AR	<i>Anonyx lilljeborgi</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
AR	Aoridae	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
AR	<i>Campylaspis biplicata</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
AR	<i>Campylaspis</i> sp F MBC	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
AR	<i>Cancer anthonyi</i>	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
AR	<i>Caprella cf verrucosa</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
AR	<i>Caprella verrucosa</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
AR	Caprellidae	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
AR	Caridea	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
AR	<i>Cirolana harfordi</i>	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
AR	<i>Crangon nigromaculata</i>	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
AR	<i>Crangon</i> sp	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
AR	<i>Cyclaspis</i> sp A SCAMIT 1995	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
AR	<i>Diastylis crenellata</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
AR	<i>Elasmopus</i> sp	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
AR	<i>Emerita analoga</i>	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
AR	<i>Hemicyclops thysanotus</i>	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
AR	<i>Hemigrapsus nudus</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
AR	<i>Hemigrapsus oregonensis</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
AR	<i>Hemigrapsus</i> sp	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
AR	<i>Heptacarpus palpator</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
AR	<i>Heteromyctis odontops</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
AR	<i>Hippomedon zetesimus</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
AR	<i>Incisocalliope bairdi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
AR	<i>Ischyrocerus anguipes</i>	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
AR	<i>Lamprops carinatus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
AR	<i>Leptostylis calva</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
AR	<i>Lysmata californica</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
AR	<i>Metacrangon spinosissima</i>	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
AR	<i>Monocorophium uenoii</i>	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
AR	<i>Munna chromatocephala</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
AR	Mysidae	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
AR	<i>Nebalia hessieri</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
AR	<i>Neomysis kodiakensis</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
AR	<i>Ogyrides</i> sp A of Roney 1978	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
AR	Ostracoda	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
AR	<i>Pagurus caurinus</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
AR	<i>Pagurus hirsutusculus</i>	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
AR	<i>Pagurus</i> sp	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
AR	<i>Paraleuthia simile</i>	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
AR	<i>Pentidotea resecata</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
AR	<i>Perasterope hulngsi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
AR	<i>Photis</i> sp B SCAMIT 1985	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
AR	<i>Pinnixa hiatus</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
AR	<i>Pinnixa tomentosa</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
AR	<i>Pinnixa weymouthi</i>	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1

Appendix G-5. (Cont.).

Phylum	Species	1972	1978	1980	1986	1988	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	Total
AR	<i>Podocopida</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
AR	<i>Pollipices polymerus</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
AR	<i>Pugettia dalli</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
AR	<i>Rhepoxynius bicuspispidatus</i>	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
AR	<i>Rhepoxynius lucubrans</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
AR	<i>Rutiderma lomae</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
AR	<i>Tetralicita squamosa rubescens</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
AR	<i>Thorlaksonius platypus</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
AR	<i>Vargula tsuji</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
AR	<i>Westwoodilla caecula</i>	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
CN	<i>Campanulariidae</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
CN	<i>Clytia universitatis</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
CN	<i>Corymorphida palma</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
CN	<i>Corynactis californica</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
CN	<i>Edwardsia californica</i>	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
CN	<i>Halcampa crypta</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
CN	<i>Metridium sp</i>	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
CN	<i>Pentactinia californica</i>	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
CO	<i>Diplosoma macdonaldi</i>	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
CO	<i>Gobiesox rheodon</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
CO	<i>Porichthys notatus</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
CO	<i>Pyura haustor</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
EC	<i>Holothuroidea</i>	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
EC	<i>Pentamera populifera</i>	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
EC	<i>Pentamerida sp</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
EC	<i>Strongylocentrotus sp</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
EH	<i>Echiura</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
EP	<i>Amathia distans</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
EP	<i>Bugula californica</i>	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
EP	<i>Celleporella hyalina</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
EP	<i>Schizoporella unicornis</i>	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
MO	<i>Aegires albopunctatus</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
MO	<i>Aglaea ocelligera</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
MO	<i>Alabina sp 1</i>	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
MO	<i>Americardia biangulata</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
MO	<i>Amiantis callosa</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
MO	<i>Anomia peruviana</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
MO	<i>Argopecten ventricosus</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
MO	<i>Armina californica</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
MO	<i>Axonopsida seminflata</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
MO	<i>Babakina festiva</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
MO	<i>Calyptraea fastigiata</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
MO	<i>Calyptraeidae</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
MO	<i>Conus californicus</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
MO	<i>Crassispira semiinflata</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
MO	<i>Crepidatella orbiculata</i>	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
MO	<i>Diaphana californica</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
MO	<i>Donax gouldii</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
MO	<i>Ennucula tenuis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
MO	<i>Epitonium spp</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
MO	<i>Fissurella volcano</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
MO	<i>Gari californica</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
MO	<i>Gasteropteron pacificum</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
MO	<i>Juliacorbula luteola</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
MO	<i>Mangelia hexagona</i>	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
MO	<i>Mangeliinae</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
MO	<i>Mya arenaria</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
MO	<i>Mysella sp C SCAMIT 1988</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
MO	<i>Mysella sp E SCAMIT 1988</i>	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
MO	<i>Nemocardium centifolium</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
MO	<i>Nuculana taphria</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
MO	<i>Odostomia clementina</i>	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
MO	<i>Olivella biplicata</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
MO	<i>Ophiodermella cancellata</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
MO	<i>Pandora sp</i>	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
MO	<i>Periploma planiusculum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
MO	<i>Pleurobranchaea californica</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
MO	<i>Pododesmus macrochisma</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
MO	<i>Polyplacophora</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
MO	<i>Pteropurpura festiva</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
MO	<i>Rissoidae</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
MO	<i>Rocheforbia compressa</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
MO	<i>Septifer bifurcata</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
MO	<i>Serpulorbis squamigerus</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
MO	<i>Sinezona rimuloides</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
MO	<i>Solen sp</i>	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
MO	<i>Thracia trapezoides</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
MO	<i>Tivela stultorum</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1

Appendix G-5. (Cont.).

Phylum	Species	1972	1978	1980	1986	1988	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	Total
MO	<i>Tresus nuttallii</i>	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
MO	<i>Turbonilla nuttingi</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
MO	<i>Turbonilla painei</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
MO	<i>Turbonilla paramoëa</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
MO	<i>Turbonilla</i> sp D MBC 1971	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
MO	<i>Vitrinella oldroydi</i>	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
MO	<i>Volvulella californica</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
MO	<i>Yoldia seminuda</i>	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
NE	<i>Cerebratulus</i> sp	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
NE	<i>Lineus bilineatus</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
NE	<i>Nemertea</i> sp A Paquette 1989	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
NE	<i>Oerstedia dorsalis</i>	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
NE	<i>Tetrasterigma signifer</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PL	<i>Imogine exigua</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
PL	<i>Leptoplanidae</i> sp A MEC 1988	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1
PL	<i>Platyhelminthes</i> sp N MBC 1983	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
PL	<i>Plehnia caeca</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
SI	<i>Siphonosoma ingens</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
SI	<i>Sipunculus nudus</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
Number of individuals		9689	2815	1779	738	2790	4354	3951	4108	6927	5078	4210	3084	1575	6482	3963	61543
Number of species		230	157	191	108	217	248	223	232	300	265	213	218	187	292	252	877
Number of stations/reps		15/3	7/1	8/1	7/1	7/4	7/4	7/4	7/4	7/4	7/4	7/4	1/1	7/4	7/4	7/4	7/4
Total biomass						28.0	1.64	26.3	17.2	25.1	51.0	30.7	17.1	16.6	30.4	22.8	266.8

## **APPENDIX H**

**Fish and macroinvertebrate underwater video station data**

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**Appendix H-1. Master species list of fish and macroinvertebrate observed during video-cine transects. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

PHYLUM	Subphylum or Class	Family	Species	Common Name
ARTHROPODA	CRUSTACEA (sub-phylum)	Malacostraca	<i>Palinuridae</i> <i>Panulirus interruptus</i>	California spiny lobster
MOLLUSCA	Gastropoda	Aglajidae	<i>Navanax inermis</i>	navanax
		Aplysiidae	<i>Aplysia californica</i>	California seahare
		Buccinidae	<i>Kelletia kelletii</i>	Kellet's whelk
		Naticidae	<i>Polinices lewisi</i>	Lewis's moon snail
		Octopodidae	<i>Octopus bimaculatus/ bimaculoides</i>	California two-spot octopus
		Turbinidae	<i>Lithopoma undosa</i>	wavy top snail
ECHINODERMATA	Echinoidea	Strongylocentrotidae	<i>Strongylocentrotus purpuratus</i>	purple sea urchin
	Holothuroidea	Parastichipodidae	<i>Parastichopus parvimensis</i>	warty sea cucumber
CHORDATA	Elasmobranchiomorphi (= Chondrichthyes, Elasmobranchii)	Rhinobatidae	<i>Pletryrhinoides triseriata</i>	thornback
	Squatinidae	<i>Squatina californica</i>	Pacific angel shark	
Osteichthyes (=Actinopterygii)	Atherinidae	<i>Atherinops affinis</i>	topsmelt	
		<i>Atherinopsis californiensis</i>	jacksmelt	
	Bothidae (= Paralichthyidae)	<i>Paralichthys californicus</i>	California halibut	
	Carangidae	<i>Seriola dorsalis</i>	yellowtail	
	Clinidae	<i>Chaenopsis alepidota</i>	orangethroat pikeblenny	
	Cottidae	<i>Scorpaenichthys marmoratus</i>	cabezon	
	Embiotocidae	<i>Embiotoca jacksoni</i>	black surfperch	
		<i>Rhacochilus vacca</i>	pile perch	
		<i>Phanerodon furcatus</i>	white seaperch	
	Gobiidae	<i>Coryphopterus nicholsii</i>	blackeye goby	
	Kyphosidae (includes Girellidae and Scorpididae)	<i>Girella nigricans</i>	opaleye	
		<i>Hermosilla azorea</i>	zebra perch	
		<i>Medialuna californiensis</i>	halfmoon	
	Labridae	<i>Halichoeres semicinctus</i>	rock wrasse	
		<i>Oxyjulis californica</i>	senorita	
	Pleuronectidae	<i>Pleuronichthys coenosus</i>	c-o turbot	
		<i>Pleuronichthys ritteri</i>	spotted turbot	
	Pomacentridae	<i>Chromis punctipinnis</i>	blacksmith	
		<i>Hypsypops rubicundus</i>	garibaldi	
	Pristipomatidae	<i>Anisotremus davidsonii</i>	sargo	
		<i>Xenistius californiensis</i>	salema	
	Scombridae	<i>Sarda chilensis</i>	Pacific bonito	
	Scorpaenidae	<i>Sebastes serranoides</i>	olive rockfish	
	Serranidae	<i>Paralabrax clathratus</i>	kelp bass	
		<i>Paralabrax nebulifer</i>	barred sandbass	
	Sphyraenidae	<i>Sphyraena argentea</i>	California barracuda	

**Appendix H-2. Fish and macroinvertebrate video-cine transect raw data by station and replicate. AES Redondo Beach L.L.C. generating station NPDES, winter 2001.**

**Fish**

Species	Station	C1			C2			C3			Grand Total	Percent Composition	Cumulative Percent
		Replicate	1	2	Total	1	2	Total	1	2	Total		
<i>Chromis punctipinnis</i>		697	682	1379	460	405	865	4	12	16	2260	52.0	52.0
<i>Anisotremus davidsonii</i>		409	275	684	120	100	220	7	1	8	912	21.0	72.9
<i>Xenistius californiensis</i>		125	150	275	-	-	-	-	-	-	275	6.3	79.3
<i>Oxyjulis californica</i>		72	106	178	140	149	289	3	1	4	471	10.8	90.1
<i>Halichoeres semicinctus</i>		4	120	124	1	-	1	-	-	-	125	2.9	93.0
<i>Sarda chiliensis</i>		100	1	101	-	-	-	-	-	-	101	2.3	95.3
<i>Atherinopsis californiensis</i>		-	50	50	-	50	50	-	-	-	100	2.3	97.6
<i>Rhacochilus vacca</i>		-	1	1	8	18	26	-	-	-	27	0.6	98.2
<i>Hypsopops rubicundus</i>		12	2	14	-	-	-	2	-	2	16	0.4	98.6
<i>Embiotoca jacksoni</i>		2	1	3	3	1	4	3	5	8	15	0.3	98.9
<i>Paralebraex clathratus</i>		5	3	8	-	-	-	3	4	7	15	0.3	99.3
<i>Girella nigricans</i>		6	2	8	-	-	-	-	-	-	8	0.2	99.4
<i>Paralebraex nebulifer</i>		-	-	-	-	-	-	5	2	7	7	0.2	99.6
<i>Pleuronichthys ritteri</i>		-	-	-	1	1	2	-	-	2	4	0.1	99.7
<i>Phanerodon furcatus</i>		1	-	1	-	1	1	1	-	1	3	0.1	99.8
<i>Squatina californica</i>		-	1	1	-	-	-	-	1	1	2	0.0	99.8
<i>Coryphopterus nicholsii</i>		-	-	-	-	-	-	-	1	1	1	0.0	99.8
<i>Hermosilla azurea</i>		1	-	1	-	-	-	-	-	-	1	0.0	99.9
<i>Paralichthys californicus</i>		-	-	-	-	-	-	1	-	1	1	0.0	99.9
<i>Platyrrhinoidis triseriata</i>		1	-	1	-	-	-	-	-	-	1	0.0	99.9
<i>Pleuronichthys coenosus</i>		-	-	-	-	-	-	-	1	1	1	0.0	99.9
<i>Scorpaenichthys marmoratus</i>		-	-	-	1	-	1	-	-	-	1	0.0	100.0
<i>Sebastes serranoides</i>		-	-	-	-	-	-	-	1	1	1	0.0	100.0
<i>Sphyraena argentea</i>		-	-	-	-	-	-	1	-	1	1	0.0	100.0

**Summary**

Parameter	Station	C1			C2			C3			Grand Total	Replicate	
		Replicate	1	2	Total	1	2	Total	1	2	Total	Mean	S.D.
Number of individuals		1435	1394	2829	734	725	1459	32	29	61	4349	724.8	619.1
Number of species		13	13	16	8	8	10	11	10	15	24	10.5	2.3
Diversity ( $H'$ )		1.38	1.49	1.50	1.00	1.23	1.14	2.22	1.82	2.26	1.50	1.52	0.44

Note: 0.00 = <0.05

**Invertebrates**

Species	Station	C1			C2			C3			Grand Total	Percent Composition	Cumulative Percent
		Replicate	1	2	Total	1	2	Total	1	2	Total		
<i>Kelletia kelletii</i>		16	8	24	7	3	10	3	2	5	39	41.1	41.1
<i>Parastichopus parvimensis</i>		6	8	14	3	3	6	3	2	5	25	26.3	67.4
<i>Lithopoma undosa</i>		10	7	17	2	4	6	-	-	-	23	24.2	91.6
<i>Polinices lewisi</i>		1	-	1	-	2	2	-	-	-	3	3.2	94.7
<i>Navanax inermis</i>		-	-	-	2	-	2	-	-	-	2	2.1	96.8
<i>Strongylocentrotus purpuratus</i>		-	-	-	-	-	-	2	-	2	2	2.1	98.9
<i>Aplysia californica</i>		-	-	-	-	-	-	-	1	1	1	1.1	100.0

**Summary**

Parameter	Station	C1			C2			C3			Grand Total	Replicate	
		Replicate	1	2	Total	1	2	Total	1	2	Total	Mean	S.D.
Number of individuals		33	23	56	14	12	26	8	5	13	95	15.8	10.4
Number of species		4	3	4	4	4	5	3	3	4	7	3.5	0.5
Diversity ( $H'$ )		1.13	1.10	1.14	1.23	1.36	1.44	1.08	1.05	1.22	1.38	1.16	0.12

**Appendix H-3. Fish and macroinvertebrate video-cine transect raw data by station and replicate. AES Redondo Beach L.L.C. generating station NPDES, summer 2001.**

**Fish**

Species	Replicate	Station			C1			C2			C3			Grand Total	Percent Composition	Cumulative Percent
		1	2	Total	1	2	Total	1	2	Total	1	2	Total			
<i>Chromis punctipinnis</i>	50	51	101	-	130	170	300	-	39	24	63	464	36.2	36.2		
<i>Anisotremus davidsonii</i>	125	94	219	-	-	-	-	-	130	-	130	349	27.2	63.4		
<i>Oxyjulis californica</i>	-	80	80	-	15	25	40	-	62	15	77	197	15.4	78.8		
<i>Rhecochilus vecca</i>	20	15	35	-	4	5	9	-	10	6	16	60	4.7	83.5		
<i>Atherinops affinis</i>	-	-	-	-	30	15	45	-	-	-	-	45	3.5	87.0		
<i>Embiotoca jacksoni</i>	20	13	33	-	-	-	-	-	24	10	34	67	5.2	92.2		
<i>Phanerodon furcatus</i>	-	-	-	-	-	-	-	-	15	6	21	21	1.6	93.8		
<i>Atherinopsis californiensis</i>	-	-	-	-	-	-	-	-	-	15	15	15	1.2	95.0		
<i>Paralabrax clathratus</i>	3	2	5	-	-	-	-	-	6	2	8	13	1.0	96.0		
<i>Paralabrax nebulifer</i>	-	-	-	-	1	3	4	-	2	7	9	13	1.0	97.0		
<i>Girella nigricans</i>	6	2	8	-	-	-	-	-	-	-	-	8	0.6	97.7		
<i>Medialuna californiensis</i>	1	-	1	-	3	4	7	-	-	-	-	8	0.6	98.3		
<i>Chaenopsis alepidota</i>	3	2	5	-	2	-	2	-	-	-	-	7	0.5	98.8		
<i>Halichoeres semicinctus</i>	4	-	4	-	-	-	-	-	-	1	1	5	0.4	99.2		
<i>Hypsypops rubicundus</i>	3	2	5	-	-	-	-	-	-	-	-	5	0.4	99.6		
<i>Coryphopterus nicholsii</i>	-	-	-	-	-	-	-	-	1	1	2	2	0.2	99.8		
<i>Hermosilla azurea</i>	1	-	1	-	-	-	-	-	-	-	-	1	0.1	99.8		
<i>Pleuronichthys ritteri</i>	1	-	1	-	-	-	-	-	-	-	-	1	0.1	99.9		
<i>Seriola dorsalis</i>	-	-	-	-	-	1	1	-	-	-	-	1	0.1	100.0		

**Summary**

Parameter	Replicate	Station			C1			C2			C3			Grand Total	Replicate	
		1	2	Total	1	2	Total	1	2	Total	1	2	Total		Total	S.D.
Number of individuals		237	261	498	185	223	408	289	87	376	1282	213.7	71.3			
Number of species		12	9	13	7	7	8	9	10	11	19	9.0	1.9			
Diversity (H')		1.48	1.51	1.63	0.97	0.87	0.94	1.57	1.97	1.85	1.80	1.4	0.4			

**Invertebrates**

Species	Replicate	Station			C1			C2			C3			Grand Total	Percent Composition	Cumulative Percent
		1	2	Total	1	2	Total	1	2	Total	1	2	Total			
<i>Kelletia kelletii</i>	5	7	12	-	4	3	7	-	3	-	3	22	64.7	64.7		
<i>Panulirus interruptus</i>	-	-	-	-	-	-	-	-	-	5	5	5	14.7	79.4		
<i>Parastichopus parvimensis</i>	1	-	1	-	1	3	4	-	-	-	-	5	14.7	94.1		
<i>Navanax inermis</i>	-	-	-	-	-	-	-	-	1	-	1	1	2.9	97.1		
<i>Octopus bimaculatus/ bimaculoides</i>	-	-	-	-	-	1	1	-	-	-	-	1	2.9	100.0		

**Summary**

Parameter	Replicate	Station			C1			C2			C3			Grand Total	Replicate	
		1	2	Total	1	2	Total	1	2	Total	1	2	Total		Total	S.D.
Number of individuals		6	7	13	5	7	12	-	4	-	5	9	34	5.7	1.2	
Number of species		2	1	2	2	3	3	-	2	-	1	3	5	1.8	0.8	
Diversity (H')		0.45	0.00	0.27	0.50	1.00	0.89	-	0.56	-	0.00	0.94	1.05	0.4	0.4	

**Appendix H-4. Abundance of fish species observed during video-cine transects, 1986 - 2001. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	Winter												Summer												Grand Total	Average Abundance n=22	FO
	1986	1988	1990	1991	1992	1993	1994	1995	1996	1998	1999	2000	2001	1986	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001			
<i>Sardinops sagax</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15367	9597.94	3
<i>Chromis punctipinnis</i>	2144	2492	755	2397	2302	2606	2669	494	743	2260	826	1365	1553	2870	2275	1407	3427	435	705	1771	302	464	36362	1652.82	22		
<i>Atherinops affinis</i>	-	-	-	-	1050	-	-	150	-	-	143	1433	-	250	-	1350	1100	1651	2835	45	32	197	7891	363.23	10		
<i>Oxyurilus californica</i>	21	33	4	308	1950	1542	341	8	113	471	34	575	317	963	300	89	643	31	15	4	32	150	15	5636	268.38	6	
<i>Atherinopsis californiensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Anisotremus davidsonii</i>	2	-	-	287	-	31	5	5	65	912	10	-	1068	-	130	1345	4	218	443	350	349	5234	290.78	16			
<i>Cymatogaster aggregata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Anchoa deliciassimile</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Halichoeres semicinctus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Brachyistius frenatus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Embiotoca jacksoni</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Rhacochilus vecca</i>	8	6	113	30	55	4	23	19	15	2	100	33	38	38	23	37	77	53	125	59	67	921	43.86	21			
<i>Paralabrax nebulifer</i>	3	-	-	155	18	29	3	14	8	27	25	148	3	6	15	22	8	2	29	60	636	30.29	21				
<i>Paralabrax clathratus</i>	11	20	6	22	16	22	38	77	10	15	16	2	10	3	8	48	31	12	32	24	12	13	448	20.36	22		
<i>Xenistius californiensis</i>	80	-	-	-	-	-	-	-	-	275	3	-	-	-	-	-	-	-	-	-	-	-	358	22.38	3		
<i>Girella nigricans</i>	1	-	-	-	50	6	31	6	1	24	8	35	28	-	35	8	11	6	15	3	68	6	344	18.11	18		
<i>Phanerodon furcatus</i>	-	-	-	-	3	-	-	-	-	2	3	-	2	-	208	-	6	2	-	77	9	21	333	19.59	10		
<i>Scomber japonicus</i>	-	-	-	-	-	-	-	-	-	325	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
<i>Lutjanus dalli</i>	-	10	-	24	-	19	-	-	-	101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Sarda chiliensis</i>	-	-	-	128	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Hypsurus caryi</i>	-	-	-	-	8	-	46	33	-	-	-	-	-	-	5	15	65	2	20	8	-	-	-	-	-	-	
<i>Sebastodes serranoides</i>	-	-	-	-	28	-	-	-	2	1	-	-	-	-	-	148	-	-	-	-	-	-	-	-	-	-	
<i>Hypsiprops rubicundus</i>	-	-	-	-	3	5	6	43	9	5	4	16	3	-	2	8	-	20	8	5	7	21	9	5	179	9.42	18
<i>Medialuna californiensis</i>	-	-	-	-	-	6	40	6	3	-	-	-	12	-	2	26	-	26	-	-	-	8	129	8.60	9		
<i>Chaenopsis alepidota</i>	-	-	-	-	-	4	-	-	-	-	2	-	-	-	8	-	13	9	15	1	-	7	60	3.75	9		
<i>Coryphopterus richardsonii</i>	-	-	-	-	4	3	4	6	-	-	-	1	-	-	7	-	2	5	4	-	1	-	25	-	-	-	
<i>Pleuronichthys coenosus</i>	-	-	-	-	2	8	9	1	-	-	1	1	-	-	8	-	6	-	1	2	-	1	-	39	2.29	11	
<i>Pleuronichthys ritteri</i>	-	-	-	-	-	3	5	3	5	3	1	4	2	-	3	3	2	3	2	-	1	-	-	-	-	-	
<i>Hyperprosopon argenteum</i>	-	-	-	-	-	-	-	-	-	-	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Heterostichus rostratus</i>	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Semicassyniphys pulcher</i>	-	-	-	-	-	8	-	2	3	-	-	-	-	-	-	2	-	6	-	1	-	-	-	-	-	-	
<i>Serrula dorsalis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	10	-	-	-	-	-	-	-	-	
<i>Umbrina palliata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	6	-	-	-	-	-	-	-	-	
<i>Citharichthys stigmaeus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2	-	-	-	-	-	-	-	-	
<i>Paralabrax triseriatus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	
<i>Hermosilla azurea</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	
<i>Hypsopsetta guttulata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-	-	
<i>Cauiolatilus princeps</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	
<i>Cheilotremus saturnum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-	-	
<i>Engraulis mordax</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	
<i>Neoclinus uninotatus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Oxyeleotris pictus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Paralabrax maculatusfasciatus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Platyrrhinoidis triseriata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Squatina californica</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2	-	-	-	-	-	-	-	-	
<i>Synodus lucioceps</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	
<i>Pleuronichthys verticalis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Rhaconichthys toxotes</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Scorpaena guttata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Scorpaenichthys marmoratus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Sphyraena argentea</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Total Individuals	2275	2558	813	3539	5578	6030	3168	841	2802	4549	2133	3225	154505	5348	4716	2712	7833	2198	2379	5033	6336	1282					
Number of Species	10	6	10	19	18	19	17	16	17	24	15	16	15	17	15	17	16	15	16	15	17	18	19	22	19		

Note: Data have been adjusted to correct for differences in visibility between surveys.

FO = Frequency of occurrence

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## **APPENDIX I**

**Fish and macroinvertebrate heat treatment and normal operation data**

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**Appendix I-1. Fish and invertebrate species impinged during heat treatments and normal operations.**  
**AES Redondo Beach L.L.C. generating station NPDES, 2001.**

PHYLUM Class Family Species	Common Name	PHYLUM Class Family Species	Common Name
<b>Cnidaria</b>			
Hydrozoa		<b>Vertebrata</b>	
Polyorchidae		Elasmobranchiomorphi (=Chondrichthyes, Elasmobranchii)	
<i>Polyorchis penicillata</i>	pencillate jellyfish	Heterodontidae	
Scyphozoa		<i>Heterodontus francisci</i>	horn shark
Pelagiidae		Carcharhinidae	
<i>Pelagia colorata</i>	purple-striped jellyfish	<i>Mustelus californicus</i>	gray smoothhound
<b>Mollusca</b>			
Gastropoda		Rhinobatidae	
Turbinidae		<i>Platyrrhinoidis triseriata</i>	thornback
<i>Megastrea (= Astraea) undosa</i>	wavy turbansnail	<i>Rhinobatos productus</i>	shovelnose guitarfish
Aplysiidae		Torpedinidae	
<i>Aplysia californica</i>	California seahare	<i>Torpedo californica</i>	Pacific electric ray
Aglajidae		Urolophidae (Dasyatidae, in part)	
<i>Navanax inermis</i>	navanax	<i>Urolophus halleri</i>	round stingray
Cephalopoda		Myliobatidae	
Loliginidae		<i>Myliobatis californica</i>	bat ray
<i>Loligo opalescens</i>	California market squid	Osteichthyes (=Actinopterygii)	
Octopodidae		Clupeidae	
<i>Octopus bimaculoides</i>	California two-spot octopus	<i>Sardinops sagax</i>	Pacific sardine
<i>Octopus rubescens</i>	red octopus	Engraulidae	
<b>Arthropoda</b>		<i>Engraulis mordax</i>	northern anchovy
Malacostraca		Ophidiidae	
Hippolytidae		<i>Chilara taylori</i>	spotted cusk-eel
<i>Heptacarpus palpator</i>	intertidal coastal shrimp	<i>Ophidion scrippsae</i>	basketweave cusk-eel
<i>Lysmata californica</i>	red rock shrimp	Batrachoididae	
Panuliridae		<i>Porichthys myriaster</i>	specklefin midshipman
<i>Panulirus interruptus</i>	California spiny lobster	<i>Porichthys notatus</i>	plainfin midshipman
Porcellanidae		Atherinidae	
<i>Petrolistes sp</i>	porcelain crab, unid.	<i>Atherinops affinis</i>	topsmelt
Majidae		<i>Atherinopsis californiensis</i>	jacksmelt
<i>Loxorhynchus grandis</i>	sheep crab	<i>Leuresthes tenuis</i>	grunion
<i>Pyromais tuberculata</i>	tuberculate pear crab	Scorpaenidae	
Cancriidae		<i>Scorpaena guttata</i>	California scorpionfish
<i>Cancer antennarius</i>	Pacific rock crab	<i>Sebastes auriculatus</i>	brown rockfish
<i>Cancer anthonyi</i>	yellow rock crab	<i>Sebastes paucispinis</i>	bocaccio
Portunidae		<i>Sebastes restrelliger</i>	grass rockfish
<i>Portunus xantusii</i>	swimming crab	<i>Sebastes serrandoides</i>	olive rockfish
Grapsidae		<i>Sebastes sp</i>	rockfish, unid.
<i>Pachygrapsus crassipes</i>	striped shore crab	Hexagrammidae	
<b>Echinodermata</b>		<i>Oxylebius pictus</i>	Painted greenling
Astroidea		Cottidae	
Asteriidae		<i>Scorpaenichthys marmoratus</i>	cabezon
<i>Pisaster sp.</i>	sea star, unid.	Serranidae	
Echinoidea		<i>Paralabrax clathratus</i>	kelp bass
Toxopneustidae		<i>Paralabrax nebulifer</i>	barred sand bass
<i>Lytechinus pictus</i>	white sea urchin	Carangidae	
Strongylocentrotidae		<i>Trechurus symmetricus</i>	jack mackerel
<i>Strongylocentrotus purpuratus</i>	Pacific purple urchin	Haemulidae	
Holothuroidea		<i>Anisotremus davidsonii</i>	sargo
Stichopodidae		<i>Xenistius californiensis</i>	salema
<i>Parastichopus parvimensis</i>	warty sea cucumber	Sciaenidae	
<i>Parastichopus sp.</i>	sea cucumber, unid	<i>Atractoscion nobilis</i>	white seabass
		<i>Cheilotrema saturnum</i>	black croaker
		<i>Genyonemus lineatus</i>	white croaker
		<i>Menticirrhus undulatus</i>	California corbina
		<i>Seriphus politus</i>	queenfish
		<i>Roncador steindachneri</i>	spotfin croaker
		<i>Umbrina voncockerelli</i>	yellowfin croaker

Appendix I-1. (Cont.).

PHYLUM Class Family Species	Common Name	PHYLUM Class Family Species	Common Name
<b>VERTEBRATA (cont)</b>			
<b>Osteichthyes (cont)</b>			
Kyphosidae (includes Girellidae and Scorpididae)		VERTEBRATA (cont)	
<i>Girella nigricans</i>	opaleye	Osteichthyes (cont)	
<i>Medialuna californiensis</i>	halfmoon	Labridae	
Embiotocidae		<i>Halichoeres semicinctus</i>	rock wrasse
<i>Amphistichus argenteus</i>	barred surfperch	<i>Oxyjulis californica</i>	senorita
<i>Cymatogaster aggregata</i>	shiner perch	<i>Semicossyphus pulcher</i>	California sheephead
<i>Embiotoca jacksoni</i>	black surfperch	Clinidae	
<i>Hyperprosopon argenteum</i>	walleye surfperch	<i>Gibbonsia elegans</i>	spotted kelpfish
<i>Hypsurus caryi</i>	rainbow seaperch	<i>Heterostichus rostratus</i>	giant kelpfish
<i>Phanerodon furcatus</i>	white seaperch	Blenniidae	
<i>Rhecochilus toxotes</i>	rubberlip seaperch	<i>Hypsoblennius gilberti</i>	rockpool blenny
<i>Rhecochilus vacca</i>	pile perch	Scombridae	
Pomacentridae		<i>Scomber japonicus</i>	chub mackerel
<i>Chromis punctipinnis</i>	blacksmith	Paralichthyidae	
		<i>Citharichthys stigmaeus</i>	speckled sanddab
		<i>Paralichthys californicus</i>	California halibut
		Pleuronectidae	
		<i>Pleuronichthys ritteri</i>	spotted turbot

**Appendix I-2. Combined abundance and biomass of fish impinged during heat treatments and normal operations at Units 5 & 6 and Units 7 & 8 between 1 October 2000 and 30 September 2001. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	Units 5 & 6		Units 7 & 8		Total		Percent	
	Abund.	Biomass	Abund.	Biomass	Abund.	Biomass	Abund.	Biomass
<i>Seriphis politus</i>	12	1.955	1723	20,562	1735	22,517	18.74	1.30
<i>Anisotremus davidsonii</i>	-	-	1058	591,816	1058	591,816	11.43	34.09
<i>Cymatogaster aggregate</i>	21	1.350	973	7,707	994	9,057	10.74	0.52
<i>Embiotoca jacksoni</i>	4	2.068	877	157,202	881	159,270	9.52	9.17
<i>Engraulis mordax</i>	2	0.220	837	4,943	839	5,163	9.06	0.30
<i>Scorpaena guttata</i>	-	-	529	129,458	529	129,458	5.72	7.46
<i>Heterostichus rostratus</i>	4	0.031	513	11,959	517	11,990	5.59	0.69
<i>Atherinopsis californiensis</i>	-	-	475	11,695	475	11,695	5.13	0.67
<i>Chromis punctipinnis</i>	-	-	329	26,817	329	26,817	3.55	1.54
<i>Cheilotrema saturnum</i>	-	-	202	14,3383	202	14,338	2.18	0.83
<i>Scorpaenichthys marmoratus</i>	-	-	179	59,568	179	59,568	1.93	3.43
<i>Amphistichus argenteus</i>	-	-	150	34,981	150	34,981	1.62	2.01
<i>Paralabrax nebulifer</i>	1	6.840	146	36,477	147	43,317	1.59	2.49
<i>Porichthys myriaster</i>	-	-	119	14,044	119	14,044	1.29	0.81
<i>Paralabrax clathratus</i>	-	-	114	17,747	114	17,747	1.23	1.02
<i>Oxyjulis californica</i>	-	-	108	6,096	108	6,096	1.17	0.35
<i>Urolophus halleri</i>	-	-	101	53,832	101	53,832	1.09	3.10
<i>Sardinops sagax</i>	-	-	86	4,899	86	4,899	0.93	0.28
<i>Paralichthys californicus</i>	-	-	83	18,871	83	18,871	0.90	1.09
<i>Menticirrhus undulatus</i>	-	-	68	17,259	68	17,259	0.73	0.99
<i>Rhacochilus vacca</i>	1	0.190	61	13,618	62	13,808	0.67	0.80
<i>Heterodontus francisci</i>	-	-	51	144,143	51	144,143	0.55	8.30
<i>Trachurus symmetricus</i>	-	-	48	10,921	48	10,921	0.52	0.63
<i>Xenistius californiensis</i>	-	-	45	1,123	45	1,123	0.49	0.06
<i>Rhacochilus toxotes</i>	-	-	34	13.19	34	13.190	0.37	0.76
<i>Hypsurus caryi</i>	1	0.017	31	3,866	32	3,883	0.35	0.22
<i>Chilida taylori</i>	-	-	31	3,095	31	3,095	0.33	0.18
<i>Torpedo californica</i>	-	-	31	251,932	31	251,932	0.33	14.51
<i>Platyrrhinoidis triseriata</i>	-	-	29	0.087	29	0.087	0.31	0.01
<i>Hyperprosopon argenteum</i>	6	0.467	20	0.658	26	1.125	0.28	0.06
<i>Porichthys notatus</i>	-	-	25	3,884	25	3,884	0.27	0.22
<i>Girella nigricans</i>	-	-	18	11,371	18	11,371	0.19	0.65
<i>Halichoeres semicinctus</i>	-	-	10	0.636	10	0.636	0.11	0.04
<i>Umbrina roncador</i>	-	-	10	0.722	10	0.722	0.11	0.04
<i>Phanerodon furcatus</i>	1	0.170	8	1.176	9	1.346	0.10	0.08
<i>Sebastes paucispinis</i>	-	-	9	0.902	9	0.902	0.10	0.05
<i>Atherinops affinis</i>	-	-	8	0.276	8	0.276	0.09	0.02
<i>Leuresthes tenuis</i>	-	-	8	0.119	8	0.119	0.09	0.01
<i>Hypsoblennius gilberti</i>	-	-	7	0.075	7	0.075	0.06	0.00
<i>Sebastes serrandoides</i>	-	-	7	0.95	7	0.950	0.08	0.05
<i>Semicossyphus pulcher</i>	-	-	7	4.02	7	4.020	0.08	0.23
<i>Atractoscion nobilis</i>	-	-	5	1.114	5	1.114	0.05	0.06
<i>Scomber japonicus</i>	-	-	4	0.91	4	0.910	0.04	0.05
<i>Sebastes auriculatus</i>	-	-	4	0.897	4	0.897	0.04	0.05
<i>Genyonemus lineatus</i>	-	-	3	0.021	3	0.021	0.03	0.00
<i>Sebastes sp</i>	-	-	3	0.673	3	0.673	0.03	0.04
<i>Gibbonsia elegans</i>	-	-	2	0.017	2	0.017	0.02	0.00
<i>Medialuna californiensis</i>	-	-	2	0.248	2	0.248	0.02	0.01
<i>Oxylebius pictus</i>	-	-	2	0.072	2	0.072	0.02	0.00
<i>Rhinobatos productus</i>	-	-	2	1.15	2	1.150	0.02	0.07
<i>Sebastes rastrelliger</i>	-	-	2	0.166	2	0.166	0.02	0.01
<i>Citharichthys stigmaeus</i>	-	-	1	0.059	1	0.059	0.01	0.00
<i>Mustelus californicus</i>	-	-	1	4.75	1	4.750	0.01	0.27
<i>Myliobatis californica</i>	1	5.420	-	-	1	5.420	0.01	0.31
<i>Ophidion scrippae</i>	-	-	1	0.007	1	0.007	0.01	0.00
<i>Pleuronichthys ritteri</i>	-	-	1	0.087	1	0.087	0.01	0.01
<i>Roncador stevensii</i>	-	-	1	0.256	1	0.256	0.01	0.01
Survey Totals	54	18,728	9202	1717,462	9256	1736,190		
Total Species	11		56		57			

**Appendix I-3. Abundance of fish impinged at Units 5 & 6 during heat treatments by date.  
AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	2001							Total	Percent Total	Cum. Percent
	30-Jan	1-Mar	1-Apr	6-May	24-Jun	29-Jul*	9-Sep			
<i>Cymatogaster aggregata</i>	-	-	-	-	-	21	-	21	38.9	38.9
<i>Seriphis politus</i>	-	-	-	-	4	7	1	12	22.2	61.1
<i>Hyperprosopon argenteum</i>	-	-	-	-	-	6	-	6	11.1	72.2
<i>Embiotoca jacksoni</i>	1	-	-	-	-	3	-	4	7.4	79.6
<i>Heterostichus rostratus</i>	-	-	-	-	-	2	2	4	7.4	87.0
<i>Engraulis mordax</i>	-	-	-	-	-	2	-	2	3.7	90.7
<i>Hypsurus caryi</i>	-	-	-	-	-	-	1	1	1.9	92.6
<i>Myliobatis californica</i>	-	-	-	-	-	1	-	1	1.9	94.4
<i>Paralabrax nebulifer</i>	-	-	-	-	-	1	-	1	1.9	96.3
<i>Phanerodon furcatus</i>	-	-	-	-	1	-	-	1	1.9	98.1
<i>Rhecochilus vacca</i>	-	-	-	-	-	1	-	1	1.9	100.0
Number of individuals	1	-	-	-	5	44	4	54		
Number of species	1	-	-	-	2	9	3	11		

\* includes second cycle on 2 August 2001.

**Appendix I-4. Biomass (kg) of fish impinged at Units 5 & 6 during heat treatments by date. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	2001							Total	Percent Total	Cum. Percent
	30-Jan	1-Mar	1-Apr	6-May	24-Jun	29-Jul*	9-Sep			
<i>Paralabrax nebulifer</i>	-	-	-	-	-	6.840	-	6.840	36.5	36.5
<i>Myliobatis californica</i>	-	-	-	-	-	5.420	-	5.420	28.9	65.5
<i>Embiotoca jacksoni</i>	0.286	-	-	-	-	1.782	-	2.068	11.0	76.5
<i>Seriphis politus</i>	-	-	-	-	0.046	1.906	0.003	1.955	10.4	86.9
<i>Cymatogaster aggregata</i>	-	-	-	-	-	1.350	-	1.350	7.2	94.2
<i>Hyperprosopon argenteum</i>	-	-	-	-	-	0.467	-	0.467	2.5	96.6
<i>Engraulis mordax</i>	-	-	-	-	-	0.220	-	0.220	1.2	97.8
<i>Rhecochilus vacca</i>	-	-	-	-	-	0.190	-	0.190	1.0	98.8
<i>Phanerodon furcatus</i>	-	-	-	-	0.170	-	-	0.170	0.9	99.7
<i>Heterostichus rostratus</i>	-	-	-	-	-	0.012	0.019	0.031	0.2	99.9
<i>Hypsurus caryi</i>	-	-	-	-	-	-	0.017	0.017	0.1	100.0
Biomass (kg)	0.286	-	-	-	0.216	18.19	0.039	18.728		

**Appendix I-5. Abundance and biomass (kg) of fish impinged during heat treatments and normal operations at Units 7 and 8 between 1 October 2000 and 30 September 2001. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	Heat Treatment		Monitored		Extrapolated*		Overall		Percent	
	Abund.	Biomass	Abund.	Biomass	Abund.	Biomass	Abund.	Biomass	Abund.	Biomass
<i>Seriphus politus</i>	498	3,649	42	0.574	1225	16,913	1723	20,562	18.72	1.20
<i>Anisotremus davidsonii</i>	718	334,948	11	8.300	340	256,868	1058	591,816	11.50	34.46
<i>Cymatogaster aggregata</i>	105	1,923	30	0.200	868	5,784	973	7,707	10.57	0.45
<i>Embiotoca jacksoni</i>	823	154,364	2	0.117	54	2,838	877	157,202	9.53	9.15
<i>Engraulis mordax</i>	21	0.084	28	0.166	816	4,859	837	4,943	9.10	0.29
<i>Scorpaena guttata</i>	251	37,185	10	3.112	278	92,273	529	129,458	5.75	7.54
<i>Heterostichus rostratus</i>	43	2,767	16	0.313	470	9,192	513	11,959	5.57	0.70
<i>Atherinopsis californiensis</i>	12	0.417	16	0.390	463	11,278	475	11,695	5.16	0.68
<i>Chromis punctipinnis</i>	267	21,618	2	0.168	62	5,199	329	26,817	3.58	1.56
<i>Cheilotrema saturnum</i>	202	14,338	-	-	-	-	202	14,338	2.20	0.83
<i>Scorpaenichthys marmoratus</i>	32	16,837	5	1.440	147	42,731	179	59,568	1.95	3.47
<i>Amphistichus argenteus</i>	-	-	5	1.170	150	34,981	150	34,981	1.63	2.04
<i>Peralabrax nebulifer</i>	146	36,477	-	-	-	-	146	36,477	1.59	2.12
<i>Porichthys myriaster</i>	2	1,156	4	0.469	117	12,888	119	14,044	1.29	0.82
<i>Peralabrax clathratus</i>	88	17,385	1	0.014	26	0.362	114	17,747	1.24	1.03
<i>Oxyjulis californica</i>	16	0.506	3	0.184	92	5,590	108	6,096	1.17	0.35
<i>Urolophus halleri</i>	41	24,830	2	0.970	60	29,002	101	53,832	1.10	3.13
<i>Sardinops sagax</i>	5	0.397	3	0.172	81	4,502	86	4,899	0.93	0.29
<i>Paralichthys californicus</i>	-	-	3	0.690	83	18,871	83	18,871	0.90	1.10
<i>Menticirrhus undulatus</i>	9	4,067	2	0.445	59	13,192	68	17,259	0.74	1.00
<i>Rhacochilus vacca</i>	31	10,030	1	0.120	30	3,588	61	13,618	0.66	0.79
<i>Heterodontus francisci</i>	25	74,271	1	2.700	26	69,872	51	144,143	0.55	8.39
<i>Trachurus symmetricus</i>	-	-	2	0.457	48	10,921	48	10,921	0.52	0.64
<i>Xenistius californiensis</i>	45	1,123	-	-	-	-	45	1,123	0.49	0.07
<i>Rhacochilus toxotes</i>	34	13,190	-	-	-	-	34	13,190	0.37	0.77
<i>Chilara taylori</i>	-	-	1	0.100	31	3,095	31	3,095	0.34	0.18
<i>Hypsurus caryi</i>	31	3,866	-	-	-	-	31	3,866	0.34	0.23
<i>Torpedo californica</i>	-	-	1	8.200	31	251,932	31	251,932	0.34	14.67
<i>Platyrrhoides triseriata</i>	-	-	1	0.003	29	0.087	29	0.087	0.32	0.01
<i>Porichthys notatus</i>	1	0.060	1	0.160	24	3,824	25	3,884	0.27	0.23
<i>Hyperprosopon argenteum</i>	20	0.658	-	-	-	-	20	0.658	0.22	0.04
<i>Girella nigricans</i>	18	11,371	-	-	-	-	18	11,371	0.20	0.66
<i>Halichoeres semicinctus</i>	10	0.636	-	-	-	-	10	0.636	0.11	0.04
<i>Umbrina roncador</i>	10	0.722	-	-	-	-	10	0.722	0.11	0.04
<i>Sebastes paucispinis</i>	9	0.902	-	-	-	-	9	0.902	0.10	0.05
<i>Atherinops affinis</i>	8	0.276	-	-	-	-	8	0.276	0.09	0.02
<i>Leuresthes tenuis</i>	8	0.119	-	-	-	-	8	0.119	0.09	0.01
<i>Phanerodon furcatus</i>	8	1.176	-	-	-	-	8	1.176	0.09	0.07
<i>Hypsoblennius gilberti</i>	7	0.075	-	-	-	-	7	0.075	0.08	0.00
<i>Sebastes serranoides</i>	7	0.950	-	-	-	-	7	0.950	0.08	0.06
<i>Semicossyphus pulcher</i>	7	4,020	-	-	-	-	7	4,020	0.08	0.23
<i>Atractoscion nobilis</i>	5	1.114	-	-	-	-	5	1.114	0.05	0.06
<i>Scomber japonicus</i>	4	0.910	-	-	-	-	4	0.910	0.04	0.05
<i>Sebastes auriculatus</i>	4	0.897	-	-	-	-	4	0.897	0.04	0.05
<i>Genyonemus lineatus</i>	3	0.021	-	-	-	-	3	0.021	0.03	0.00
<i>Sebastes sp</i>	3	0.673	-	-	-	-	3	0.673	0.03	0.04
<i>Gibbonsia elegans</i>	2	0.017	-	-	-	-	2	0.017	0.02	0.00
<i>Medialuna californiensis</i>	2	0.248	-	-	-	-	2	0.248	0.02	0.01
<i>Oxylebius pictus</i>	2	0.072	-	-	-	-	2	0.072	0.02	0.00
<i>Rhinobatos productus</i>	2	1.150	-	-	-	-	2	1.150	0.02	0.07
<i>Sebastes restrelliger</i>	2	0.166	-	-	-	-	2	0.166	0.02	0.01
<i>Citharichthys stigmaeus</i>	1	0.059	-	-	-	-	1	0.059	0.01	0.00
<i>Mustelus californicus</i>	1	4.750	-	-	-	-	1	4.750	0.01	0.28
<i>Ophidion scrippae</i>	1	0.007	-	-	-	-	1	0.007	0.01	0.00
<i>Pleuronichthys ritteri</i>	1	0.087	-	-	-	-	1	0.087	0.01	0.01
<i>Roncador steenisii</i>	1	0.256	-	-	-	-	1	0.256	0.01	0.01
<b>Survey Totals</b>	<b>3592</b>	<b>806,820</b>	<b>193</b>	<b>30,634</b>	<b>5610</b>	<b>910,642</b>	<b>9202</b>	<b>1717,462</b>		
<b>Total Species</b>	<b>50</b>		<b>25</b>		<b>25</b>		<b>56</b>			

\* Extrapolations based on flow during month sampled divided by flow on date sampled, times abundance/biomass on sampling date. 11 days sampled during year, totaling 3.03% of the annual circulation through plant.

**Appendix I-6. Abundance of fish impinged at Units 7 & 8 during heat treatments. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	2000												2001			Percent Total	Cum. Percent
	1-Oct	5-Nov	9-Jan	27-Jan	18-Feb	25-Mar	22-Apr	22-May	19-Jun	17-Jul	19-Aug	23-Sep	Total	Total	Total		
<i>Embiotoca jacksoni</i>	341	62	83	23	3	41	21	27	68	8	79	67	823	22.91	22.9		
<i>Anisotremus davidsonii</i>	22	9	64	86	72	229	31	111	40	-	17	37	718	19.99	42.9		
<i>Seriphus politus</i>	237	107	4	5	10	65	20	-	15	-	29	6	498	13.86	56.8		
<i>Chromis punctipinnis</i>	14	13	1	4	-	2	6	34	47	60	35	51	267	7.43	64.2		
<i>Scorpaena guttata</i>	12	14	14	15	21	11	27	31	45	12	19	30	251	6.99	71.2		
<i>Cheilotrema saturnum</i>	15	52	13	8	7	8	2	10	40	-	3	44	202	5.62	76.8		
<i>Paralabrax nebulifer</i>	27	5	6	8	9	11	4	3	11	-	29	33	146	4.06	80.9		
<i>Cymatogaster aggregata</i>	4	4	1	3	1	19	12	-	48	-	13	-	105	2.92	83.8		
<i>Parelabrax clathratus</i>	6	8	2	3	2	4	2	6	18	4	16	17	88	2.45	86.2		
<i>Xenistius californiensis</i>	1	11	23	1	1	5	-	-	1	-	2	-	45	1.25	87.5		
<i>Heterostichus rostratus</i>	9	3	4	10	2	2	-	-	1	5	4	3	43	1.20	88.7		
<i>Urolophus halleri</i>	-	-	-	1	1	-	1	3	27	8	-	-	41	1.14	89.8		
<i>Rhacochilus toxotes</i>	6	-	5	4	1	1	1	1	3	10	2	-	34	0.95	90.8		
<i>Scorpaenichthys marmoratus</i>	2	-	-	3	1	2	3	3	8	3	5	2	32	0.89	91.7		
<i>Hypsurus caryi</i>	3	1	1	10	1	5	5	3	2	-	-	-	31	0.86	92.5		
<i>Rhacochilus vacca</i>	2	1	-	-	-	4	2	2	2	6	5	7	31	0.86	93.4		
<i>Heterodontus francisci</i>	-	-	-	-	-	7	12	1	1	4	-	-	25	0.70	94.1		
<i>Engraulis mordax</i>	9	-	-	-	-	1	1	-	1	-	8	1	21	0.58	94.7		
<i>Hyperprosopon argenteum</i>	1	-	-	7	-	4	-	-	8	-	-	-	20	0.56	95.2		
<i>Girella nigricans</i>	6	1	-	2	-	2	-	1	2	-	1	3	18	0.50	95.7		
<i>Oxyjulis californica</i>	-	1	2	-	1	1	-	-	4	-	3	4	16	0.45	96.2		
<i>Atherinopsis californiensis</i>	-	-	-	12	-	-	-	-	-	-	-	-	12	0.33	96.5		
<i>Helichoeres semicinctus</i>	1	-	-	4	1	-	-	-	-	-	-	-	4	10	0.28	96.8	
<i>Umbrina roncador</i>	5	-	-	-	-	1	-	-	2	-	1	1	10	0.28	97.1		
<i>Menticirrhus undulatus</i>	-	-	-	-	-	-	1	-	5	1	-	2	9	0.25	97.3		
<i>Sebastodes paucispinis</i>	3	5	-	-	1	-	-	-	-	-	-	-	9	0.25	97.6		
<i>Atherinops affinis</i>	-	-	-	-	-	7	-	-	-	-	1	-	8	0.22	97.8		
<i>Leuresthes tenuis</i>	-	-	1	-	7	-	-	-	-	-	-	-	8	0.22	98.0		
<i>Phanerodon furcatus</i>	5	-	-	2	-	-	1	-	-	-	-	-	8	0.22	98.2		
<i>Hypsoblennius gilberti</i>	-	-	-	-	-	7	-	-	-	-	-	-	7	0.19	98.4		
<i>Sebastodes serrandoides</i>	-	-	-	-	-	5	-	2	-	-	-	-	7	0.19	98.6		
<i>Semicossyphus pulcher</i>	-	-	-	-	-	1	-	-	-	-	1	5	7	0.19	98.8		
<i>Atrectoscion nobilis</i>	-	-	-	-	-	-	-	-	1	-	1	3	5	0.14	99.0		
<i>Sardinops sagax</i>	-	-	-	1	1	1	2	-	-	-	-	-	5	0.14	99.1		
<i>Scomber japonicus</i>	-	-	-	-	-	4	-	-	-	-	-	-	4	0.11	99.2		
<i>Sebastodes auriculatus</i>	1	2	-	-	-	-	1	-	-	-	-	-	4	0.11	99.3		
<i>Genyonemus lineatus</i>	1	-	-	-	1	-	-	1	-	-	-	-	3	0.08	99.4		
<i>Sebastodes sp</i>	-	-	-	1	2	-	-	-	-	-	-	-	3	0.08	99.5		
<i>Gibbonsia elegans</i>	-	1	-	1	-	-	-	-	-	-	-	-	2	0.06	99.6		
<i>Medialuna californiensis</i>	-	-	-	1	-	-	-	-	-	-	-	1	2	0.06	99.6		
<i>Oxylebius pictus</i>	1	-	-	-	1	-	-	-	-	-	-	-	2	0.06	99.7		
<i>Porichthys myriaster</i>	-	-	-	-	-	-	-	-	1	1	-	-	2	0.06	99.7		
<i>Rhinobatos productus</i>	-	-	-	-	-	-	-	-	-	2	-	-	2	0.06	99.8		
<i>Sebastodes rastrelliger</i>	1	1	-	-	-	-	-	-	-	-	-	-	2	0.06	99.8		
<i>Citharichthys stigmaeus</i>	-	-	-	-	1	-	-	-	-	-	-	-	1	0.03	99.9		
<i>Mustelus californicus</i>	-	-	-	-	-	-	1	-	-	-	-	-	1	0.03	99.9		
<i>Ophidion scriptum</i>	-	-	-	-	-	-	-	-	1	-	-	-	1	0.03	99.9		
<i>Pleuronichthys ritteri</i>	-	-	-	-	-	-	-	-	-	-	1	-	1	0.03	99.9		
<i>Porichthys notatus</i>	-	-	-	-	-	-	-	1	-	-	-	-	1	0.03	100.0		
<i>Roncador stearnsii</i>	-	-	-	-	-	-	-	-	1	-	-	-	1	0.03	100.0		
Number of individuals	735	301	224	215	148	450	156	240	403	124	275	321	3592				
Number of species	26	19	15	24	23	27	21	17	27	13	22	20	50				

**Appendix I-7. Biomass (kg) of fish impinged at Units 7 & 8 during heat treatments by month. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	2000												2001			Percent Cum.		
	1-Oct	5-Nov	9-Jan	27-Jan	18-Feb	25-Mar	22-Apr	22-May	19-Jun	17-Jul	19-Aug	23-Sep	Total	Total	Total	Percent		
<i>Anisotremus davidsonii</i>	9.030	2.178	29.390	33.350	29.580	112.320	13.830	55.750	20.470	-	8.700	20.350	334.95	<b>41.51</b>	<b>41.5</b>			
<i>Embiotoca jacksoni</i>	73.960	12.730	15.510	2.361	0.213	4.860	3.350	3.500	12.530	2.250	13.400	9.700	154.36	<b>19.13</b>	<b>60.6</b>			
<i>Heterodontus francisci</i>						23.000	37.800	3.500	0.471	9.500	-	-	74.271	<b>9.21</b>	<b>69.9</b>			
<i>Scorpaena guttata</i>	1.140	2.097	1.948	2.050	4.050	2.410	3.080	4.800	6.180	2.500	3.450	3.480	37.185	<b>4.61</b>	<b>74.5</b>			
<i>Paralabrax nebulifer</i>	4.440	0.360	1.175	4.500	2.618	5.100	0.830	0.700	3.904	-	6.900	5.950	36.477	<b>4.52</b>	<b>79.0</b>			
<i>Urolophus halleri</i>	-	-	-	0.375	0.715	-	1.200	2.450	14.840	5.250	-	-	24.830	<b>3.08</b>	<b>82.1</b>			
<i>Chromis punctipinnis</i>	0.786	0.453	0.026	0.148	-	0.303	0.435	3.700	3.867	6.000	3.000	2.900	21.618	<b>2.68</b>	<b>84.7</b>			
<i>Paralabrax clathratus</i>	2.384	1.068	0.192	0.180	0.020	0.750	0.301	2.000	3.200	3.300	2.150	1.840	17.385	<b>2.15</b>	<b>86.9</b>			
<i>Scorpaenichthys marmoratus</i>	1.115	-	-	1.092	0.373	1.090	3.603	1.350	3.544	1.500	2.300	0.870	16.837	<b>2.09</b>	<b>89.0</b>			
<i>Cheilotrema satumum</i>	1.351	2.208	0.467	0.391	0.102	0.234	0.215	1.080	4.040	-	0.450	3.800	14.338	<b>1.78</b>	<b>90.8</b>			
<i>Rhacochilus toxotes</i>	2.295	-	1.503	1.330	0.752	0.084	0.101	0.470	1.255	4.250	1.150	-	13.190	<b>1.63</b>	<b>92.4</b>			
<i>Girella nigricans</i>	3.515	0.589	-	1.492	-	0.715	-	1.150	1.390	-	1.300	1.220	11.371	<b>1.41</b>	<b>93.8</b>			
<i>Rhacochilus vacca</i>	0.269	0.159	-	-	-	0.250	0.118	0.570	0.714	2.750	1.550	3.650	10.030	<b>1.24</b>	<b>95.0</b>			
<i>Mustelus californicus</i>	-	-	-	-	-	-	4.750	-	-	-	-	4.750	-	<b>0.59</b>	<b>95.6</b>			
<i>Menticirrhus undulatus</i>	-	-	-	-	-	-	0.095	-	2.047	1.750	-	0.175	4.067	<b>0.50</b>	<b>96.1</b>			
<i>Semicossyphus pulcher</i>	-	-	-	-	-	0.950	-	-	-	-	0.600	2.470	4.020	<b>0.50</b>	<b>96.6</b>			
<i>Hypsurus caryi</i>	0.446	0.034	0.111	1.900	0.041	0.405	0.581	0.260	0.088	-	-	-	3.866	<b>0.48</b>	<b>97.1</b>			
<i>Seriphis politus</i>	1.323	0.371	0.067	0.018	0.088	0.710	0.176	-	0.091	-	0.703	0.102	3.649	<b>0.45</b>	<b>97.6</b>			
<i>Heterostichus rostratus</i>	0.460	0.296	0.281	0.439	0.042	0.520	-	-	0.029	0.450	0.098	0.152	2.767	<b>0.34</b>	<b>97.9</b>			
<i>Cymatogaster aggregata</i>	0.060	0.045	0.057	0.095	0.029	0.790	0.399	-	0.374	-	0.074	-	1.923	<b>0.24</b>	<b>98.1</b>			
<i>Phanerodon furcatus</i>	0.845	-	-	0.094	-	-	0.237	-	-	-	-	-	1.176	<b>0.15</b>	<b>98.3</b>			
<i>Porichthys myriaster</i>	-	-	-	-	-	-	-	-	0.006	1.150	-	-	1.156	<b>0.14</b>	<b>98.4</b>			
<i>Rhinobatos productus</i>	-	-	-	-	-	-	-	-	-	1.150	-	-	1.150	<b>0.14</b>	<b>98.6</b>			
<i>Xenistius californiensis</i>	0.064	0.323	0.432	0.008	0.006	0.029	-	-	0.068	-	0.193	-	1.123	<b>0.14</b>	<b>98.7</b>			
<i>Atractoscion nobilis</i>	-	-	-	-	-	-	-	-	0.374	-	0.300	0.440	1.114	<b>0.14</b>	<b>98.9</b>			
<i>Sebastodes serrandooides</i>	-	-	-	-	-	0.490	-	0.460	-	-	-	-	0.950	<b>0.12</b>	<b>99.0</b>			
<i>Scomber japonicus</i>	-	-	-	-	-	0.910	-	-	-	-	-	-	0.910	<b>0.11</b>	<b>99.1</b>			
<i>Sebastodes paucispinis</i>	0.245	0.549	-	-	0.108	-	-	-	-	-	-	-	0.902	<b>0.11</b>	<b>99.2</b>			
<i>Sebastodes auriculatus</i>	0.160	0.630	-	-	-	-	0.107	-	-	-	-	-	0.897	<b>0.11</b>	<b>99.3</b>			
<i>Umbrina roncador</i>	0.039	-	-	-	-	0.100	-	-	0.183	-	0.127	0.273	0.722	<b>0.09</b>	<b>99.4</b>			
<i>Sebastes sp</i>	-	-	-	0.192	0.481	-	-	-	-	-	-	-	0.673	<b>0.08</b>	<b>99.5</b>			
<i>Hyperprosopon argenteum</i>	0.012	-	-	0.344	-	0.234	-	-	0.068	-	-	-	0.658	<b>0.08</b>	<b>99.6</b>			
<i>Halichoeres semicinctus</i>	0.005	-	-	0.087	0.069	-	-	-	-	-	-	-	0.475	0.636	<b>0.08</b>	<b>99.6</b>		
<i>Oxyjulis californica</i>	-	0.047	0.082	-	0.005	0.005	-	-	0.265	-	0.037	0.065	0.506	<b>0.06</b>	<b>99.7</b>			
<i>Atherinopsis californiensis</i>	-	-	-	0.417	-	-	-	-	-	-	-	-	0.417	<b>0.05</b>	<b>99.8</b>			
<i>Sardinops sagax</i>	-	-	-	0.056	0.054	0.051	0.236	-	-	-	-	-	0.397	<b>0.05</b>	<b>99.8</b>			
<i>Atherinops affinis</i>	-	-	-	-	-	0.236	-	-	-	0.040	-	-	0.276	<b>0.03</b>	<b>99.8</b>			
<i>Roncador stearnsii</i>	-	-	-	-	-	-	-	0.256	-	-	-	-	0.256	<b>0.03</b>	<b>99.9</b>			
<i>Medialuna californiensis</i>	-	-	-	0.077	-	-	-	-	-	-	-	0.171	0.248	<b>0.03</b>	<b>99.9</b>			
<i>Sebastes rastrelliger</i>	0.090	0.076	-	-	-	-	-	-	-	-	-	-	0.166	<b>0.02</b>	<b>99.9</b>			
<i>Leuresthes tenuis</i>	-	-	0.028	-	0.091	-	-	-	-	-	-	-	0.119	<b>0.01</b>	<b>99.9</b>			
<i>Pleuronichthys ritteri</i>	-	-	-	-	-	-	-	-	-	-	0.087	-	0.087	<b>0.01</b>	<b>100.0</b>			
<i>Engraulis mordax</i>	0.017	-	-	-	-	0.011	0.003	-	0.006	-	0.044	0.003	0.084	<b>0.01</b>	<b>100.0</b>			
<i>Hypsoblennius gilberti</i>	-	-	-	-	-	0.075	-	-	-	-	-	-	0.075	<b>0.01</b>	<b>100.0</b>			
<i>Oxylebius pictus</i>	0.052	-	-	-	0.020	-	-	-	-	-	-	-	0.072	<b>0.01</b>	<b>100.0</b>			
<i>Porichthys notatus</i>	-	-	-	-	-	-	0.060	-	-	-	-	-	0.060	<b>0.01</b>	<b>100.0</b>			
<i>Citharichthys stigmaeus</i>	-	-	-	-	0.059	-	-	-	-	-	-	-	0.059	<b>0.01</b>	<b>100.0</b>			
<i>Genyonemus lineatus</i>	0.012	-	-	-	0.004	-	-	0.005	-	-	-	-	0.021	<b>0.00</b>	<b>100.0</b>			
<i>Gibbonsia elegans</i>	-	0.012	-	0.005	-	-	-	-	-	-	-	-	0.017	<b>0.00</b>	<b>100.0</b>			
<i>Ophidion scrippsae</i>	-	-	-	-	-	-	-	0.007	-	-	-	-	0.007	<b>0.00</b>	<b>100.0</b>			
Biomass (kg)	104.115	24.225	51.269	51.001	39.520	156.632	71.447	81.805	80.267	41.800	46.653	58.086	806.820					

**Appendix I-8. Abundance of fish impinged at Units 7 & 8 during normal operation by month. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	2000		2001										Percent Total	Cum. Percent
	NOV 29	DEC 20	JAN 26	FEB 27	MAR 6	APR 20	MAY 29	JUN 28	JUL 31	AUG 17	SEP 29			
<i>Seriphis politus</i>	-	-	-	-	-	-	-	9	1	-	32	42	21.76	21.8
<i>Cymatogaster aggregata</i>	-	-	-	-	-	-	-	-	-	-	30	30	15.54	37.3
<i>Engraulis mordax</i>	-	-	-	-	-	-	-	6	-	-	22	28	14.51	51.8
<i>Atherinopsis californiensis</i>	-	-	-	-	-	-	-	-	-	16	16	8.29	60.1	
<i>Heterostichus rostratus</i>	1	-	1	2	-	1	-	1	3	4	3	16	8.29	68.4
<i>Anisotremus davidsonii</i>	-	-	-	-	-	-	-	-	11	-	-	11	5.70	74.1
<i>Scorpaena guttata</i>	-	-	-	1	2	1	1	1	1	2	1	10	5.18	79.3
<i>Amphistichus argenteus</i>	-	-	-	-	-	-	-	5	-	-	-	5	2.59	81.9
<i>Scorpaenichthys marmoratus</i>	-	-	1	1	-	-	-	-	2	-	1	5	2.59	84.5
<i>Porichthys myriaster</i>	-	-	-	-	-	-	1	2	-	1	-	4	2.07	86.5
<i>Oxyjulis californica</i>	-	-	-	-	-	-	-	1	2	-	-	3	1.55	88.1
<i>Paralichthys californicus</i>	-	-	1	-	-	-	-	-	-	2	-	3	1.55	89.6
<i>Sardinops sagax</i>	-	-	1	1	1	-	-	-	-	-	-	3	1.55	91.2
<i>Chromis punctipinnis</i>	-	-	-	-	-	-	-	-	2	-	-	2	1.04	92.2
<i>Embiotoca jacksoni</i>	-	-	-	-	1	-	-	1	-	-	-	2	1.04	93.3
<i>Menticirrhus undulatus</i>	-	-	-	-	-	-	-	1	-	-	1	2	1.04	94.3
<i>Trechurus symmetricus</i>	-	-	-	-	2	-	-	-	-	-	-	2	1.04	95.3
<i>Urophorus halleri</i>	-	-	-	-	-	-	-	2	-	-	-	2	1.04	96.4
<i>Chilæra taylori</i>	-	-	-	-	-	-	-	-	1	-	-	1	0.52	96.9
<i>Heterodontus francisci</i>	-	-	-	1	-	-	-	-	-	-	-	1	0.52	97.4
<i>Paralabrax clathratus</i>	-	-	-	1	-	-	-	-	-	-	-	1	0.52	97.9
<i>Platyrrhinoidis triseriata</i>	-	-	-	-	-	-	-	-	-	-	1	1	0.52	98.4
<i>Porichthys notatus</i>	-	-	-	-	1	-	-	-	-	-	-	1	0.52	99.0
<i>Rhacochilus vacca</i>	-	-	-	-	-	-	-	1	-	-	-	1	0.52	99.5
<i>Torpedo californica</i>	-	-	1	-	-	-	-	-	-	-	-	1	0.52	100.0
Number of individuals	1	-	5	7	7	2	2	30	23	9	107	193		
Number of species	1	-	5	6	5	2	2	11	8	4	9	25		

**Appendix I-9. Biomass (kg) of fish impinged at Units 7 & 8 during normal operation by month. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	2000		2001										Percent Total	Cum. Percent
	NOV 29	DEC 20	JAN 26	FEB 27	MAR 6	APR 20	MAY 29	JUN 28	JUL 31	AUG 17	SEP 29			
<i>Anisotremus davidsonii</i>	-	-	-	-	-	-	-	-	8.300	-	-	8.300	27.09	27.1
<i>Torpedo californica</i>	-	-	8.200	-	-	-	-	-	-	-	-	8.200	26.77	53.9
<i>Scorpaena guttata</i>	-	-	-	0.140	0.260	1.600	0.092	0.150	0.400	0.300	0.170	3.112	10.16	64.0
<i>Heterodontus francisci</i>	-	-	-	2.700	-	-	-	-	-	-	-	2.700	8.81	72.8
<i>Scorpaenichthys marmoratus</i>	-	-	0.130	0.220	-	-	-	-	0.750	-	0.340	1.440	4.70	77.5
<i>Amphistichus argenteus</i>	-	-	-	-	-	-	-	-	1.170	-	-	1.170	3.82	81.4
<i>Urophorus halleri</i>	-	-	-	-	-	-	-	0.970	-	-	-	0.970	3.17	84.5
<i>Paralichthys californicus</i>	-	-	0.180	-	-	-	-	-	-	0.510	-	0.690	2.25	86.8
<i>Seriphis politus</i>	-	-	-	-	-	-	-	0.210	0.053	-	0.311	0.574	1.87	88.6
<i>Porichthys myriaster</i>	-	-	-	-	-	-	0.063	0.086	-	0.320	-	0.469	1.53	90.2
<i>Trechurus symmetricus</i>	-	-	-	-	0.457	-	-	-	-	-	-	0.457	1.49	91.7
<i>Menticirrhus undulatus</i>	-	-	-	-	-	-	-	0.330	-	-	0.115	0.445	1.45	93.1
<i>Atherinopsis californiensis</i>	-	-	-	-	-	-	-	-	-	-	0.390	0.390	1.27	94.4
<i>Heterostichus rostratus</i>	0.018	-	0.017	0.020	-	0.030	-	0.010	0.080	0.110	0.028	0.313	1.02	95.4
<i>Cymatogaster aggregata</i>	-	-	-	-	-	-	-	-	-	-	0.200	0.200	0.65	96.1
<i>Oxyjulis californica</i>	-	-	-	-	-	-	-	0.100	0.084	-	-	0.184	0.60	96.7
<i>Sardinops sagax</i>	-	-	0.037	0.070	0.065	-	-	-	-	-	-	0.172	0.56	97.2
<i>Chromis punctipinnis</i>	-	-	-	-	-	-	-	-	0.168	-	-	0.168	0.55	97.8
<i>Engraulis mordax</i>	-	-	-	-	-	-	-	0.060	-	-	0.106	0.166	0.54	98.3
<i>Porichthys notatus</i>	-	-	-	-	0.160	-	-	-	-	-	-	0.160	0.52	98.8
<i>Rhacochilus vacca</i>	-	-	-	-	-	-	-	0.120	-	-	-	0.120	0.39	99.2
<i>Embiotoca jacksoni</i>	-	-	-	-	0.110	-	-	0.007	-	-	-	0.117	0.38	99.6
<i>Chilæra taylori</i>	-	-	-	-	-	-	-	-	0.100	-	-	0.100	0.33	99.9
<i>Paralabrax clathratus</i>	-	-	-	0.014	-	-	-	-	-	-	-	0.014	0.05	100.0
Biomass (kg)	0.018	-	8.564	3.164	1.052	1.630	0.155	3.213	9.935	1.240	1.663	30.634		

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**Appendix I-10. Abundance of fish impinged during heat treatments between 1 October 2000 and 30 September 2001. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	Units 5 & 6		Units 7 & 8		Overall	
	Total	Abundance	Total	Abundance	Total	Percent
<i>Embiotoca jacksoni</i>	4	7.4	823	22.9	827	22.7
<i>Anisotremus davidsonii</i>	-	-	718	20.0	718	19.7
<i>Seriphus politus</i>	12	22.2	498	13.9	510	14.0
<i>Chromis punctipinnis</i>	-	-	267	7.4	267	7.3
<i>Scorpaena guttata</i>	-	-	251	7.0	251	6.9
<i>Cheilotrema saturnum</i>	-	-	202	5.6	202	5.5
<i>Paralabrax nebulifer</i>	1	1.9	146	4.1	147	4.0
<i>Cymatogaster aggregata</i>	21	38.9	105	2.9	126	3.5
<i>Paralabrax clathratus</i>	-	-	88	2.4	88	2.4
<i>Heterostichus rostratus</i>	4	7.4	43	1.2	47	1.3
<i>Xenistius californiensis</i>	-	-	45	1.3	45	1.2
<i>Urolophus halleri</i>	-	-	41	1.1	41	1.1
<i>Rhacochilus toxotes</i>	-	-	34	0.9	34	0.9
<i>Hypsurus caryi</i>	1	1.9	31	0.9	32	0.9
<i>Rhacochilus vacca</i>	1	1.9	31	0.9	32	0.9
<i>Scorpaenichthys marmoratus</i>	-	-	32	0.9	32	0.9
<i>Hyperoplus argenteum</i>	6	11.1	20	0.6	26	0.7
<i>Heterodontus francisci</i>	-	-	25	0.7	25	0.7
<i>Engraulis mordax</i>	2	3.7	21	0.6	23	0.6
<i>Girella nigricans</i>	-	-	18	0.5	18	0.5
<i>Oxyjulis californica</i>	-	-	16	0.4	16	0.4
<i>Atherinopsis californiensis</i>	-	-	12	0.3	12	0.3
<i>Halichoeres semicinctus</i>	-	-	10	0.3	10	0.3
<i>Umbrina roncador</i>	-	-	10	0.3	10	0.3
<i>Menticirrhus undulatus</i>	-	-	9	0.3	9	0.2
<i>Phanerodon furcatus</i>	1	1.9	8	0.2	9	0.2
<i>Sebastes paucispinis</i>	-	-	9	0.3	9	0.2
<i>Atherinops affinis</i>	-	-	8	0.2	8	0.2
<i>Leuresthes tenuis</i>	-	-	8	0.2	8	0.2
<i>Hypsoblennius gilberti</i>	-	-	7	0.2	7	0.2
<i>Sebastodes serrandoides</i>	-	-	7	0.2	7	0.2
<i>Semicossyphus pulcher</i>	-	-	7	0.2	7	0.2
<i>Atractoscion nobilis</i>	-	-	5	0.1	5	0.1
<i>Sardinops sagax</i>	-	-	5	0.1	5	0.1
<i>Scomber japonicus</i>	-	-	4	0.1	4	0.1
<i>Sebastes auriculatus</i>	-	-	4	0.1	4	0.1
<i>Genyonemus lineatus</i>	-	-	3	0.1	3	0.1
<i>Sebastes sp</i>	-	-	3	0.1	3	0.1
<i>Gibbonsia elegans</i>	-	-	2	0.1	2	0.1
<i>Medialuna californiensis</i>	-	-	2	0.1	2	0.1
<i>Oxylebius pictus</i>	-	-	2	0.1	2	0.1
<i>Porichthys myriaster</i>	-	-	2	0.1	2	0.1
<i>Rhinobatos productus</i>	-	-	2	0.1	2	0.1
<i>Sebastes restrelliger</i>	-	-	2	0.1	2	0.1
<i>Citharichthys stigmaeus</i>	-	-	1	0.0	1	0.0
<i>Mustelus californicus</i>	-	-	1	0.0	1	0.0
<i>Myliobatis californica</i>	1	1.9	-	-	1	0.0
<i>Ophidion scrippae</i>	-	-	1	0.0	1	0.0
<i>Pleuronichthys ritteri</i>	-	-	1	0.0	1	0.0
<i>Porichthys notatus</i>	-	-	1	0.0	1	0.0
<i>Ranchedor stevensii</i>	-	-	1	0.0	1	0.0
<b>Survey Totals</b>	<b>54</b>		<b>3592</b>		<b>3646</b>	
<b>Total Species</b>	<b>11</b>		<b>50</b>		<b>51</b>	

Note: 0.0 = <0.05

**Appendix I-11. Biomass of fish impinged during heat treatments between 1 October 2000 and 30 September 2001. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	Units 5 & 6		Units 7 & 8		Overall	
	Total Biomass	Percent	Total Biomass	Percent	Total Biomass	Percent
<i>Anisotremus davidsonii</i>	-	-	334.948	41.5	334.948	40.6
<i>Embiotoca jacksoni</i>	2.068	11.0	154.364	19.1	156.432	18.9
<i>Heterodontus francisci</i>	-	-	74.271	9.2	74.271	9.0
<i>Paralabrax nebulifer</i>	6.840	36.5	36.477	4.5	43.317	5.2
<i>Scorpeena guttata</i>	-	-	37.185	4.6	37.185	4.5
<i>Urolophus halleri</i>	-	-	24.830	3.1	24.830	3.0
<i>Chromis punctipinnis</i>	-	-	21.618	2.7	21.618	2.6
<i>Paralabrax clathratus</i>	-	-	17.385	2.2	17.385	2.1
<i>Scorpaenichthys marmoratus</i>	-	-	16.837	2.1	16.837	2.0
<i>Cheilotrema saturnum</i>	-	-	14.338	1.8	14.338	1.7
<i>Rhacochilus taxotes</i>	-	-	13.190	1.6	13.190	1.6
<i>Girella nigricans</i>	-	-	11.371	1.4	11.371	1.4
<i>Rhacochilus vacca</i>	0.190	1.0	10.030	1.2	10.220	1.2
<i>Seriphus politus</i>	1.955	10.4	3.649	0.5	5.604	0.7
<i>Myliobatis californica</i>	5.420	28.9	-	-	5.420	0.7
<i>Mustelus californicus</i>	-	-	4.750	0.6	4.750	0.6
<i>Menticirrhus undulatus</i>	-	-	4.067	0.5	4.067	0.5
<i>Semicossyphus pulcher</i>	-	-	4.020	0.5	4.020	0.5
<i>Hypsurus caryi</i>	0.017	0.1	3.866	0.5	3.883	0.5
<i>Cymatogaster aggregata</i>	1.350	7.2	1.923	0.2	3.273	0.4
<i>Heterostichus rostratus</i>	0.031	0.2	2.767	0.3	2.798	0.3
<i>Phanerodon furcatus</i>	0.170	0.9	1.176	0.1	1.346	0.2
<i>Porichthys myriaster</i>	-	-	1.156	0.1	1.156	0.1
<i>Rhinobatos productus</i>	-	-	1.150	0.1	1.150	0.1
<i>Hyperprosopon argenteum</i>	0.467	2.5	0.658	0.1	1.125	0.1
<i>Xenistius californiensis</i>	-	-	1.123	0.1	1.123	0.1
<i>Atractoscion nobilis</i>	-	-	1.114	0.1	1.114	0.1
<i>Sebastes serrandoides</i>	-	-	0.950	0.1	0.950	0.1
<i>Scomber japonicus</i>	-	-	0.910	0.1	0.910	0.1
<i>Sebastes paucispinis</i>	-	-	0.902	0.1	0.902	0.1
<i>Sebastes auriculatus</i>	-	-	0.897	0.1	0.897	0.1
<i>Umbrina roncador</i>	-	-	0.722	0.1	0.722	0.1
<i>Sebastes sp</i>	-	-	0.673	0.1	0.673	0.1
<i>Halichoeres semicinctus</i>	-	-	0.636	0.1	0.636	0.1
<i>Oxyjulis californica</i>	-	-	0.506	0.1	0.506	0.1
<i>Atherinopsis californiensis</i>	-	-	0.417	0.1	0.417	0.1
<i>Sardinops sagax</i>	-	-	0.397	0.0	0.397	0.0
<i>Engraulis mordax</i>	0.220	1.2	0.084	0.0	0.304	0.0
<i>Atherinops affinis</i>	-	-	0.276	0.0	0.276	0.0
<i>Roncador stearnsii</i>	-	-	0.256	0.0	0.256	0.0
<i>Medialuna californiensis</i>	-	-	0.248	0.0	0.248	0.0
<i>Sebastes restrelliger</i>	-	-	0.166	0.0	0.166	0.0
<i>Leuresthes tenuis</i>	-	-	0.119	0.0	0.119	0.0
<i>Pleuronichthys ritteri</i>	-	-	0.087	0.0	0.087	0.0
<i>Hypsoblennius gilberti</i>	-	-	0.075	0.0	0.075	0.0
<i>Oxylebius pictus</i>	-	-	0.072	0.0	0.072	0.0
<i>Porichthys notatus</i>	-	-	0.060	0.0	0.060	0.0
<i>Citharichthys stigmaeus</i>	-	-	0.059	0.0	0.059	0.0
<i>Genyonemus lineatus</i>	-	-	0.021	0.0	0.021	0.0
<i>Gibbonsia elegans</i>	-	-	0.017	0.0	0.017	0.0
<i>Ophidion scriptae</i>	-	-	0.007	0.0	0.007	0.0
Number of Totals	18.728		806.820		825.548	
Number of Species	11		50		51	

Note: 0.0 values are less than 0.05

**Appendix I-12. Abundance and biomass (kg) of invertebrates impinged during heat treatments and extrapolated normal operations. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	Units 5 & 6		Units 7 & 8		Total		Percent	
	Abund.	Biomass	Abund.	Biomass	Abundance	Biomass	Abund.	Biomass
<i>Penulirus interruptus</i> *	1	2.354	2552	1054.862	2553	1057.216	68.59	76.43
<i>Loligo opalescens</i>	-	-	249	68.257	249	68.257	6.69	4.93
<i>Pachygrapsus crassipes</i>	2	0.001	145	0.782	147	0.783	3.95	0.06
<i>Loxorhynchus grandis</i>	-	-	133	105.068	133	105.068	3.57	7.60
<i>Portunus xantisii</i>	-	-	113	2.206	113	2.206	3.04	0.16
<i>Lysmata californica</i>	-	-	100	0.060	100	0.060	2.69	0.00
<i>Cancer antennarius</i>	5	0.024	88	0.114	93	0.138	2.50	0.01
<i>Octopus bimaculoides</i>	2	1.600	87	44.371	89	45.971	2.39	3.32
<i>Polyorchis penicillata</i>	-	-	57	40.803	57	40.803	1.53	2.95
<i>Octopus rubescens</i>	-	-	42	4.184	42	4.184	1.13	0.30
<i>Pyromnia tuberculata</i>	1	0.011	37	0.064	38	0.075	1.02	0.01
<i>Pelagia colorata</i>	1	3.650	31	40.300	32	43.950	0.86	3.18
<i>Parastichopus parvimensis</i>	1	0.085	26	2.616	27	2.701	0.73	0.20
<i>Cancer anthonyi</i>	-	-	9	0.037	9	0.037	0.24	0.00
<i>Aplysia vaccaria</i>	7	0.740	-	-	7	0.740	0.19	0.05
<i>Strongylocentrotus purpuratus</i>	-	-	6	0.430	6	0.430	0.16	0.03
<i>Heptacarpus palpator</i>	-	-	5	9.000	5	9.000	0.13	0.65
<i>Cancer gracilis</i>	4	0.004	-	-	4	0.004	0.11	0.00
<i>Navanax inermis</i>	3	0.017	1	0.005	4	0.022	0.11	0.00
<i>Norrisia norrisi</i>	3	0.001	-	-	3	0.001	0.08	0.00
<i>Parastichopus</i> sp.	-	-	2	0.111	2	0.111	0.05	0.01
<i>Pisaster</i> sp.	-	-	2	1.117	2	1.117	0.05	0.08
<i>Aplysia californica</i>	-	-	1	0.050	1	0.050	0.03	0.00
<i>Lytechinus pictus</i>	-	-	1	0.001	1	0.001	0.03	0.00
<i>Megastrea undosa</i>	-	-	1	0.152	1	0.152	0.03	0.01
<i>Parastichopus californicus</i>	1	0.135	-	-	1	0.135	0.03	0.01
<i>Petrolistes</i> sp	-	-	1	0.002	1	0.002	0.03	0.00
<i>Pugettia producta</i>	1	0.013	-	-	1	0.013	0.03	0.00
<i>Telipus nuttalli</i>	1	0.006	-	-	1	0.006	0.03	0.00
Survey Totals	33	8.641	3689	1374.592	3722	1383.233		
Total Species	14		23		29			

\**Penulirus interruptus* extrapolation was adjusted due to high abundance and biomass on a single sampling date. The average of all sampling dates was substituted to calculate extrapolation

**Appendix I-13. Abundance of macroinvertebrates impinged at Units 5 & 6 during heat treatments by date. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	2001								Percent Total	Cum. Percent
	30-Jan	1-Mar	1-Apr	6-May	24-Jun	29-Jul*	9-Sep	Total		
<i>Panulirus interruptus</i>	-	-	-	-	2	5	-	7	21.21	21.2
<i>Pyromnia tuberculata</i>	4	-	-	-	-	1	-	5	15.15	36.4
<i>Navanax inermis</i>	-	-	2	-	-	-	2	4	12.12	48.5
<i>Cancer antennarius</i>	-	-	-	1	-	2	-	3	9.09	57.6
<i>Pelagia colorata</i>	-	-	-	-	1	2	-	3	9.09	66.7
<i>Octopus bimaculoides</i>	-	-	-	-	2	-	-	2	6.06	72.7
<i>Pugettia producta</i>	1	-	1	-	-	-	-	2	6.06	78.8
<i>Aplysia vaccaria</i>	-	-	-	1	-	-	-	1	3.03	81.8
<i>Cancer gracilis</i>	-	-	-	-	1	-	-	1	3.03	84.8
<i>Norrisia norrisi</i>	-	1	-	-	-	-	-	1	3.03	87.9
<i>Pachygrapsus crassipes</i>	-	-	-	-	-	1	-	1	3.03	90.9
<i>Parastichopus californicus</i>	-	-	-	-	-	-	1	1	3.03	93.9
<i>Parastichopus parvimensis</i>	-	-	-	-	-	1	-	1	3.03	97.0
<i>Taliepus nuttalli</i>	-	-	-	-	-	1	-	1	3.03	100.0
Number of individuals	5	1	3	2	6	13	3	33		
Number of species	2	1	2	2	4	7	2	14		

\* includes second cycle on 2 August 2001.

**Appendix I-14. Biomass (kg) of macroinvertebrates impinged at Units 5 & 6 during heat treatments by date. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	2001								Percent Total	Cum. Percent
	30-Jan	1-Mar	1-Apr	6-May	24-Jun	29-Jul*	9-Sep	Total		
<i>Pelagia colorata</i>	-	-	-	-	1.850	1.800	-	3.650	42.24	42.2
<i>Panulirus interruptus</i>	-	-	-	-	0.550	1.804	-	2.354	27.24	69.5
<i>Octopus bimaculoides</i>	-	-	-	-	1.600	-	-	1.600	18.52	88.0
<i>Aplysia vaccaria</i>	-	-	-	0.740	-	-	-	0.740	8.56	96.6
<i>Parastichopus californicus</i>	-	-	-	-	-	-	0.135	0.135	1.56	98.1
<i>Parastichopus parvimensis</i>	-	-	-	-	-	0.085	-	0.085	0.98	99.1
<i>Cancer antennarius</i>	-	-	-	0.002	-	0.022	-	0.024	0.28	99.4
<i>Navanax inermis</i>	-	-	0.005	-	-	-	0.012	0.017	0.20	99.6
<i>Pugettia producta</i>	0.003	-	0.010	-	-	-	-	0.013	0.15	99.7
<i>Pyromnia tuberculata</i>	0.009	-	-	-	-	0.002	-	0.011	0.13	99.9
<i>Taliepus nuttalli</i>	-	-	-	-	-	0.006	-	0.006	0.07	99.9
<i>Cancer gracilis</i>	-	-	-	-	0.004	-	-	0.004	0.05	100.0
<i>Norrisia norrisi</i>	-	0.001	-	-	-	-	-	0.001	0.01	100.0
<i>Pachygrapsus crassipes</i>	-	-	-	-	-	0.001	-	0.001	0.01	100.0
Biomass (kg)	0.012	0.001	0.015	0.742	4.004	3.720	0.147	8.641		

\* includes second cycle on 2 August 2001.

**Appendix I-15. Abundance of macroinvertebrates impinged at Units 7 & 8 during normal operation by month. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	2000										2001										Percent	Cum.
	Date	NOV 29	DEC 20	JAN 26	FEB 27	MAR 6	APR 20	MAY 29	JUN 28	JUL 31	AUG 17	SEP 29	Total									
<i>Panulirus interruptus</i>		7	1	2	31	7	5	4	5	7	5	6	80	82.47	82.5							
<i>Loligo opalescens</i>		-	-	2	-	-	1	-	-	1	-	-	4	4.12	86.6							
<i>Portunus xantusii</i>		-	-	-	2	-	-	1	-	-	1	-	4	4.12	90.7							
<i>Loxorhynchus grandis</i>		-	-	-	-	-	-	-	1	-	1	-	2	2.06	92.8							
<i>Octopus bimaculatus/bimaculoide</i>		-	-	-	-	-	1	-	1	-	-	-	2	2.06	94.8							
<i>Polyorchis penicillata</i>		-	-	-	-	-	-	1	-	-	1	-	2	2.06	96.9							
<i>Cancer antennarius</i>		-	-	1	-	-	-	-	-	-	-	-	1	1.03	97.9							
<i>Octopus rubescens</i>		1	-	-	-	-	-	-	-	-	-	-	1	1.03	97.9							
<i>Parastichopus parvimensis</i>		-	-	-	-	-	-	-	-	-	1	-	1	1.03	99.0							
Number of individuals		8	1	5	33	7	7	6	7	7	7	10	6	97								
Number of species		2	1	3	2	1	3	3	3	1	6	1	9									

**Appendix I-16. Biomass (kg) of macroinvertebrates impinged at Units 7 & 8 during normal operation by month. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	2000										2001										Percent	Cum.
	Date	NOV 29	DEC 20	JAN 26	FEB 27	MAR 6	APR 20	MAY 29	JUN 28	JUL 31	AUG 17	SEP 29	Total	Total	Total	Total	Total	Total	Total	Total		
<i>Panulirus interruptus</i>		1.800	0.260	0.450	10.030	2.200	4.300	2.330	2.860	3.900	1.100	1.900	31.130	80.46	80.5							
<i>Loxorhynchus grandis</i>		-	-	-	-	-	-	-	1.500	-	1.420	-	2.920	7.55	88.0							
<i>Loligo opalescens</i>		-	-	0.047	-	-	2.100	-	-	-	0.040	-	2.187	5.65	93.7							
<i>Polyorchis penicillata</i>		-	-	-	-	-	-	0.220	-	1.300	-	1.520	3.93	97.6								
<i>Octopus bimaculoides</i>		-	-	-	-	-	0.160	-	0.500	-	-	-	0.660	1.71	99.3							
<i>Octopus rubescens</i>	0.100	-	-	-	-	-	-	-	-	-	-	-	0.100	0.26	99.6							
<i>Parastichopus parvimensis</i>		-	-	-	-	-	-	-	-	-	0.100	-	0.100	0.26	99.8							
<i>Portunus xantusii</i>		-	-	-	0.002	-	-	0.050	-	0.020	-	0.072	0.19	100.0								
<i>Cancer antennarius</i>		-	-	0.001	-	-	-	-	-	-	-	-	0.001	0.00	100.0							
Biomass (kg)		1.900	0.260	0.498	10.032	2.200	6.560	2.600	4.860	3.900	3.980	1.900	38.690									

Note: 0.00 = <0.005

**Appendix I-17. Abundance of macroinvertebrates impinged at Units 7 & 8 during heat treatments. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	2000										2001										Percent Total	Cum. Percent
	1-Oct	5-Nov	9-Jan	27-Jan	18-Feb	25-Mar	22-Apr	22-May	19-Jun	17-Jul	19-Aug	23-Sep	Total									
<i>Panulirus interruptus</i>	70	12	14	43	49	13	27	49	20	63	240	256	856	66.51	66.5							
<i>Pachygrapsus crassipes</i>	65	18	1	4	30	-	-	-	24	-	3	-	145	11.27	77.8							
<i>Lysmata californica</i>	-	-	35	-	-	-	-	50	-	-	-	15	100	7.77	85.5							
<i>Pyromeria tuberculata</i>	12	12	-	-	1	2	-	-	-	-	-	10	37	2.87	88.4							
<i>Pelagia colorata</i>	-	-	-	-	-	-	-	-	1	30	-	-	31	2.41	90.8							
<i>Cancer antennarius</i>	2	5	-	-	-	-	-	-	2	-	18	-	27	2.10	92.9							
<i>Octopus bimaculoides</i>	5	1	1	1	3	2	-	3	-	6	2	2	26	2.02	94.9							
<i>Loxorhynchus grandis</i>	-	-	-	-	-	1	-	2	5	10	3	-	21	1.63	96.6							
<i>Loligo opalescens</i>	-	-	1	1	9	-	-	-	-	-	-	-	11	0.85	97.4							
<i>Cancer anthonyi</i>	-	4	-	-	-	-	-	-	-	-	5	-	9	0.70	98.1							
<i>Strongylocentrotus purpuratus</i>	-	-	-	-	-	3	-	3	-	-	-	-	6	0.47	98.6							
<i>Heptacarpus palpator</i>	-	-	-	-	-	-	5	-	-	-	-	-	5	0.39	99.0							
<i>Portunus xantusii</i>	-	-	-	-	-	-	1	-	-	-	1	2	4	0.31	99.3							
<i>Parastichopus sp</i>	-	-	-	-	1	-	1	-	-	-	-	-	2	0.16	99.5							
<i>Pisaster sp</i>	-	-	1	-	-	1	-	-	-	-	-	-	2	0.16	99.6							
<i>Aplysia californica</i>	-	-	-	-	-	-	-	-	-	1	-	-	1	0.08	99.7							
<i>Lytechinus pictus</i>	-	-	-	-	-	1	-	-	-	-	-	-	1	0.08	99.8							
<i>Megastrea undosa</i>	-	-	-	-	-	-	-	-	1	-	-	-	1	0.08	99.8							
<i>Navanax inermis</i>	-	1	-	-	-	-	-	-	-	-	-	-	1	0.08	99.9							
<i>Petrolistes sp</i>	-	-	-	-	-	1	-	-	-	-	-	-	1	0.08	100.0							
Number of individuals	154	53	53	49	93	24	34	107	53	110	272	285	1287									
Number of species	5	7	6	4	6	8	4	5	6	5	7	5	20									

**Appendix I-18. Biomass (kg) of macroinvertebrates impinged at Units 7 & 8 during heat treatments. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	2000										2001										Percent Total	Cum. Percent
	1-Oct	5-Nov	9-Jan	27-Jan	18-Feb	25-Mar	22-Apr	22-May	19-Jun	17-Jul	19-Aug	23-Sep	Total									
<i>Panulirus interruptus</i>	36.380	5.849	6.450	11.000	18.808	7.450	20.500	55.500	6.450	22.500	82.400	74.100	347.387	77.65	77.7							
<i>Pelagia colorata</i>	-	-	-	-	-	-	-	-	0.300	40.000	-	-	40.300	9.01	86.7							
<i>Octopus bimaculoides</i>	4.370	1.360	0.693	2.000	5.300	4.500	-	0.750	-	4.500	0.202	0.750	24.425	5.46	92.1							
<i>Loxorhynchus grandis</i>	-	-	-	-	-	2.000	-	3.500	6.376	7.500	3.700	-	23.076	5.16	97.3							
<i>Heptacarpus palpator</i>	-	-	-	-	-	-	9.000	-	-	-	-	-	9.000	2.01	99.3							
<i>Pisaster sp</i>	-	-	1.017	-	-	0.100	-	-	-	-	-	-	1.117	0.25	99.5							
<i>Pachygrapsus crassipes</i>	0.220	0.118	0.003	0.025	0.230	-	-	-	0.110	-	0.076	-	0.782	0.17	99.7							
<i>Strongylocentrotus purpuratus</i>	-	-	-	-	-	0.180	-	0.250	-	-	-	-	0.430	0.10	99.8							
<i>Loligo opalescens</i>	-	-	0.023	0.012	0.151	-	-	-	-	-	-	-	0.186	0.04	99.9							
<i>Megastrea undosa</i>	-	-	-	-	-	-	-	-	0.152	-	-	-	0.152	0.03	99.9							
<i>Parastichopus sp</i>	-	-	-	-	0.101	-	0.010	-	-	-	-	-	0.111	0.02	99.9							
<i>Portunus xantusii</i>	-	-	-	-	-	0.008	-	-	-	-	0.008	0.070	0.086	0.02	99.9							
<i>Cancer antennarius</i>	0.005	0.015	-	-	-	-	-	-	0.002	-	0.061	-	0.083	0.02	100.0							
<i>Pyromeria tuberculata</i>	0.020	0.024	-	-	0.002	0.008	-	-	-	-	-	-	0.010	0.064	0.01	100.0						
<i>Lysmata californica</i>	-	-	0.040	-	-	-	0.005	-	-	-	-	-	0.015	0.060	0.01	100.0						
<i>Aplysia californica</i>	-	-	-	-	-	-	-	-	0.050	-	-	-	0.050	0.01	100.0							
<i>Cancer anthonyi</i>	-	0.012	-	-	-	-	-	-	-	-	0.025	-	0.037	0.01	100.0							
<i>Navanax inermis</i>	-	0.005	-	-	-	-	-	-	-	-	-	-	0.005	0.00	100.0							
<i>Petrolistes sp</i>	-	-	-	-	-	0.002	-	-	-	-	-	-	0.002	0.00	100.0							
<i>Lytechinus pictus</i>	-	-	-	-	-	0.001	-	-	-	-	-	-	0.001	0.00	100.0							
Biomass (kg)	40.995	7.383	8.226	13.037	24.592	14.241	29.518	60.005	13.390	74.550	86.472	74.945	447.354									

Note: 0.00 = <0.005

**Appendix I-19. Abundance and biomass (kg) of macroinvertebrates impinged during heat treatments and normal operations at Units 7 and 8 between 1 October 2000 and 30 September 2001. AES Redondo Beach L.L.C. generating station NPDES, 2001.**

Species	Heat Treatment		Monitored		Extrapolated*		Overall		Percent	
	Abund.	Biomass	Abund.	Biomass	Abund.	Biomass	Abund.	Biomass	Abund.	Biomass
<i>Panulirus interruptus</i> **	856	347.387	80	31.130	1696	707.475	2552	1054.862	69.18	76.74
<i>Loligo opalescens</i>	11	0.186	4	2.187	238	68.071	249	68.257	6.75	4.97
<i>Pachygrapsus crassipes</i>	145	0.782	-	-	-	-	145	0.782	3.93	0.06
<i>Loxorhynchus grandis</i>	21	23.076	2	2.920	112	81.992	133	105.068	3.61	7.64
<i>Portunus xantisii</i>	4	0.086	4	0.072	109	2.120	113	2.206	3.06	0.16
<i>Lysmata californica</i>	100	0.060	-	-	-	-	100	0.060	2.71	0.00
<i>Cancer antennarius</i>	27	0.083	1	0.001	61	0.031	88	0.114	2.39	0.01
<i>Octopus bimaculoides</i>	26	24.425	2	0.660	61	19.946	87	44.371	2.36	3.23
<i>Polyorchis penicillata</i>	-	-	2	1.520	57	40.803	57	40.803	1.55	2.97
<i>Octopus rubescens</i>	-	-	1	0.100	42	4.184	42	4.184	1.14	0.30
<i>Pyromais tuberculata</i>	37	0.064	-	-	-	-	37	0.064	1.00	0.00
<i>Pelagia colorata</i>	31	40.300	-	-	-	-	31	40.300	0.84	2.93
<i>Parastichopus parvimensis</i>	-	-	1	0.100	26	2.616	26	2.616	0.70	0.19
<i>Cancer anthonyi</i>	9	0.037	-	-	-	-	9	0.037	0.24	0.00
<i>Strongylocentrotus purpuratus</i>	6	0.430	-	-	-	-	6	0.430	0.16	0.03
<i>Heptacarpus palpator</i>	5	9.000	-	-	-	-	5	9.000	0.14	0.65
<i>Parastichopus</i> sp	2	0.111	-	-	-	-	2	0.111	0.05	0.01
<i>Pisaster</i> sp	2	1.117	-	-	-	-	2	1.117	0.05	0.08
<i>Aplysia californica</i>	1	0.050	-	-	-	-	1	0.050	0.03	0.00
<i>Lytechinus pictus</i>	1	0.001	-	-	-	-	1	0.001	0.03	0.00
<i>Megastreae undosa</i>	1	0.152	-	-	-	-	1	0.152	0.03	0.01
<i>Navanax inermis</i>	1	0.005	-	-	-	-	1	0.005	0.03	0.00
<i>Petrolistes</i> sp	1	0.002	-	-	-	-	1	0.002	0.03	0.00
Survey Totals	1287	447.354	97	38.690	2402	927.238	3689	1374.592		
Total Species	20		9		9		23			

\* Extrapolations based on flow during month sampled divided by flow on date sampled, multiplied by abundance/biomass on sampling date: 11 days sampled during year, totaling 3.03% of the annual circulation through plant.

\*\* *Panulirus interruptus* extrapolation was adjusted due to high abundance and biomass on a single sampling date. The average of all sampling dates was substituted to calculate extrapolation.

Note: 0.00 = <0.005

**Appendix I-20. Total abundance of fish impinged during heat treatments and normal operations, 1991 - 2001.  
AES Redondo Beach L.L.C. generating station NPDES, 2001.**

SPECIES	Year											Percent		
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Total	Total	Mean
<i>Sardinops sagax</i>	3	36334	1951	228	68	1	87	81	67	305	86	39210	29.73	3564.6
<i>Chromis punctipinnis</i>	7960	1282	18145	497	1790	402	1676	632	132	91	329	32935	24.97	2994.1
<i>Seriphis politus</i>	3715	2716	485	655	166	150	2883	156	261	939	1735	13860	10.51	1260.0
<i>Cymatogaster aggregata</i>	1343	1094	31	94	816	1318	56	20	781	130	994	6677	5.06	607.0
<i>Paralabrax clathratus</i>	856	475	466	147	357	203	408	491	43	94	114	3654	2.77	332.2
<i>Scorpaena guttata</i>	469	317	237	274	1006	399	115	49	52	205	529	3652	2.77	332.0
<i>Xenistius californiensis</i>	2138	-	8	661	371	-	72	204	34	51	45	3584	2.72	325.8
<i>Embiotoca jacksoni</i>	234	116	271	34	82	363	425	63	279	144	881	2893	2.19	263.0
<i>Engraulis mordax</i>	552	800	97	35	98	34	176	19	2	215	839	2868	2.17	260.7
<i>Cheilotrema saturnum</i>	161	376	67	288	92	25	148	686	8	53	202	2107	1.60	191.5
<i>Paralabrax nebulifer</i>	258	210	221	167	265	64	127	236	24	44	147	1764	1.34	160.3
<i>Anisotremus davidsonii</i>	167	72	46	37	38	7	94	158	1	39	1058	1717	1.30	156.1
<i>Heterostichus rostratus</i>	175	161	26	132	116	79	49	10	77	38	517	1381	1.05	125.5
<i>Rhacochilus vacca</i>	197	274	241	46	45	23	258	51	172	7	62	1376	1.04	125.1
<i>Atherinops affinis</i>	24	10	10	2	52	10	1120	48	40	-	8	1325	1.00	120.4
<i>Forichthys notatus</i>	723	17	48	37	243	3	34	24	-	30	25	1185	0.90	107.7
<i>Platythyridoides triseriate</i>	406	128	39	14	68	122	1	58	38	-	29	903	0.68	82.1
<i>Atherinopsis californiensis</i>	-	9	68	-	31	7	273	28	-	-	475	892	0.68	81.1
<i>Hypsurus caryi</i>	168	93	229	40	55	34	107	32	2	92	32	885	0.67	80.4
<i>Brachystius frenatus</i>	336	412	42	1	3	42	7	2	-	-	-	845	0.64	76.9
<i>Oxyjulis californica</i>	205	62	90	61	105	9	128	6	-	3	108	777	0.59	70.6
<i>Girella nigricans</i>	177	246	45	26	34	7	47	51	-	7	18	658	0.50	59.9
<i>Phanerodon furcatus</i>	188	156	26	9	21	66	99	11	4	14	9	603	0.46	54.8
<i>Urophorus halleri</i>	67	23	28	13	87	10	60	40	37	78	101	544	0.41	49.5
<i>Rhacochilus toxotes</i>	68	42	103	15	10	55	70	46	3	19	34	465	0.35	42.3
<i>Scorpaenichthys marmoratus</i>	107	56	29	22	5	2	12	1	1	4	179	418	0.32	38.0
<i>Trachurus symmetricus</i>	26	6	3	31	7	7	223	1	-	-	48	352	0.27	32.0
<i>Sebastes serranoides</i>	71	254	6	1	-	-	-	-	7	2	7	348	0.26	31.6
<i>Torpedo californica</i>	114	17	10	-	62	1	-	1	37	-	31	273	0.21	24.8
<i>Heterodontus francisci</i>	77	10	9	4	6	5	4	22	20	64	51	272	0.21	24.7
<i>Porichthys myriaster</i>	56	-	-	1	30	1	-	1	21	30	119	259	0.20	23.6
<i>Umbrina roncador</i>	20	5	5	34	93	3	9	10	1	62	10	252	0.19	22.9
<i>Halichoeres semicinctus</i>	53	10	35	12	40	10	1	38	7	15	10	232	0.18	21.1
<i>Paralichthys californicus</i>	-	7	9	13	-	2	-	5	9	62	83	190	0.14	17.3
<i>Hyperoplus argenteus</i>	58	54	1	1	1	1	9	1	-	23	26	175	0.13	15.9
<i>Pleuronichthys ritteri</i>	37	8	2	5	63	1	4	47	2	-	1	170	0.13	15.5
<i>Myliobatis californica</i>	29	59	47	-	2	-	-	1	-	30	1	169	0.13	15.4
<i>Sebastes paucispinis</i>	53	21	-	-	-	-	1	-	69	-	9	153	0.12	13.9
<i>Amphistichus argenteus</i>	-	-	-	-	-	-	-	-	-	-	150	150	0.11	13.6
<i>Pleuronichthys verticalis</i>	2	15	38	27	30	-	-	24	8	-	-	145	0.11	13.2
<i>Citharichthys stigmatus</i>	99	-	-	2	-	2	37	-	-	-	1	141	0.11	12.8
<i>Menticirrhus undulatus</i>	24	-	-	6	2	-	3	13	2	18	68	136	0.10	12.4
<i>Chilara taylori</i>	2	12	5	1	-	4	70	2	-	1	31	127	0.10	11.6
<i>Pleuronichthys coenosus</i>	27	6	10	9	-	2	69	2	-	-	-	125	0.10	11.4
<i>Gibbonsia elegans</i>	73	-	-	3	1	38	-	-	3	-	2	120	0.09	10.9
<i>Genyonemus lineatus</i>	2	11	17	32	-	3	-	1	5	30	3	104	0.08	9.5
<i>Semicossyphus pulcher</i>	1	8	16	13	4	2	34	6	1	1	7	93	0.07	8.5
<i>Atractoscion nobilis</i>	51	11	2	8	2	-	2	-	-	3	5	84	0.06	7.6
<i>Symphurus atricauda</i>	1	-	-	21	61	1	-	-	-	-	-	84	0.06	7.6
<i>Scomber japonicus</i>	-	16	9	-	31	3	1	-	17	-	4	81	0.06	7.4
<i>Medialuna californiensis</i>	6	27	25	3	3	-	-	2	1	-	2	69	0.05	6.3
<i>Sebastes auriculatus</i>	19	7	4	8	2	1	-	2	-	3	4	50	0.04	4.5
<i>Embiotoca lateralis</i>	49	-	-	-	-	-	-	-	-	-	-	49	0.04	4.5
<i>Sebastes sericeps</i>	31	12	-	1	-	-	1	-	-	-	-	45	0.03	4.1
<i>Ophidion scriptum</i>	27	1	1	9	-	-	-	5	-	-	1	44	0.03	4.0
<i>Hypsoblennius gilberti</i>	1	-	1	23	-	1	2	-	-	7	35	0.03	3.2	
<i>Paralabrax maculatusfasciatus</i>	1	-	1	-	1	-	1	-	-	30	-	34	0.03	3.1
<i>Sebastes restrelliger</i>	15	2	-	2	1	7	-	-	-	-	2	29	0.02	2.6
<i>Leuresthes tenuis</i>	2	1	-	1	2	-	-	2	-	-	8	16	0.01	1.5
<i>Eptatretus stouti</i>	-	-	-	9	-	-	-	-	-	-	9	0.01	0.8	
<i>Hypsoprops rubicundus</i>	4	-	2	-	-	-	-	1	1	-	-	8	0.01	0.7
<i>Gobiesox rheissodon</i>	2	-	-	1	-	1	1	2	-	-	-	7	0.01	0.6
<i>Synodus lucioceps</i>	-	6	-	-	-	-	-	1	-	-	-	7	0.01	0.6
<i>Caulolatilus princeps</i>	-	6	-	-	-	-	-	-	-	-	-	6	0.00	0.5
<i>Hypsopsetta guttulata</i>	2	-	-	-	-	-	-	4	-	-	-	6	0.00	0.5

**Appendix I-20. (Cont.).**

SPECIES	Year												Percent		
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Total	Total	Mean	
<i>Mola mola</i>	-	6	-	-	-	-	-	-	-	-	-	6	0.00	0.5	
<i>Oxyplebius pictus</i>	-	-	-	-	-	-	-	1	-	2	2	5	0.00	0.5	
<i>Rhinobatos productus</i>	-	-	1	1	-	-	-	1	-	-	2	5	0.00	0.5	
<i>Artedius notospilotus</i>	4	-	-	-	-	-	-	-	-	-	-	4	0.00	0.4	
<i>Sebastes mystinus</i>	2	1	-	-	-	1	-	-	-	-	-	4	0.00	0.4	
<i>Artedius corallinus</i>	2	-	-	-	1	-	-	-	-	-	-	3	0.00	0.3	
<i>Paraclinus integrifinnis</i>	3	-	-	-	-	-	-	-	-	-	-	3	0.00	0.3	
<i>Pleuronichthys decurrens</i>	-	3	-	-	-	-	-	-	-	-	-	3	0.00	0.3	
<i>Ruscarius creaseri</i>	-	-	-	-	2	-	-	-	1	-	-	3	0.00	0.3	
<i>Sebastes sp</i>	-	-	-	-	-	-	-	-	-	-	3	3	0.00	0.3	
<i>Anchoa compressa</i>	-	-	1	-	-	-	-	1	-	-	-	2	0.00	0.2	
<i>Hypsoblennius jenkinsi</i>	-	2	-	-	-	-	-	-	-	-	-	2	0.00	0.2	
<i>Leptocottus armatus</i>	-	-	-	1	-	-	-	1	-	-	-	2	0.00	0.2	
<i>Sebastes miniatus</i>	-	-	-	-	-	-	-	-	2	-	-	2	0.00	0.2	
<i>Syngnathus</i> sp	-	-	-	-	2	-	-	-	-	-	-	2	0.00	0.2	
<i>Tilapia mossambica</i>	-	-	2	-	-	-	-	-	-	-	-	2	0.00	0.2	
<i>Triakis semifasciata</i>	-	-	-	-	-	-	1	1	-	-	-	2	0.00	0.2	
<i>Cephaloscyllium ventriosum</i>	1	-	-	-	-	-	-	-	-	-	-	1	0.00	0.1	
<i>Chaenopsis alepidota</i>	-	-	-	-	-	-	-	1	-	-	-	1	0.00	0.1	
<i>Cottidae, unid.</i>	-	-	-	-	-	1	-	-	-	-	-	1	0.00	0.1	
Fish unid.	1	-	-	-	-	-	-	-	-	-	-	1	0.00	0.1	
<i>Gibbonsia metzi</i>	1	-	-	-	-	-	-	-	-	-	-	1	0.00	0.1	
<i>Hyperprosopon ellipticum</i>	-	-	-	-	-	-	1	-	-	-	-	1	0.00	0.1	
<i>Micrometrus minimus</i>	-	-	-	1	-	-	-	-	-	-	-	1	0.00	0.1	
<i>Mustelus californicus</i>	-	-	-	-	-	-	-	-	-	-	1	1	0.00	0.1	
<i>Ophiodon elongatus</i>	-	-	-	-	-	-	1	-	-	-	-	1	0.00	0.1	
<i>Orthopristis tricolor</i>	1	-	-	-	-	-	-	-	-	-	-	1	0.00	0.1	
<i>Peprilus simillimus</i>	1	-	-	-	-	-	-	-	-	-	-	1	0.00	0.1	
<i>Pomacanthus zonipectus</i>	-	-	-	-	-	-	-	1	-	-	-	1	0.00	0.1	
<i>Ranocodon stevensii</i>	-	-	-	-	-	-	-	-	-	-	1	1	0.00	0.1	
<i>Sebastes dalli</i>	-	-	-	1	-	-	-	-	-	-	-	1	0.00	0.1	
<i>Sebastes melanops</i>	-	-	-	-	-	1	-	-	-	-	-	1	0.00	0.1	
<i>Squalus acanthias</i>	-	-	1	-	-	-	-	-	-	-	-	1	0.00	0.1	
<i>Squatina californica</i>	-	-	-	-	-	-	-	-	1	-	-	1	0.00	0.1	
<i>Syngnathus leptorhynchus</i>	-	-	-	-	-	-	-	-	1	-	-	1	0.00	0.1	
<i>Xystreurus liolepis</i>	-	1	-	-	-	-	-	-	-	-	-	1	0.00	0.1	
Total	21748	46086	23312	3820	6478	3533	9010	3406	2276	2978	9256	131904		11991.3	
Number of species	67	56	53	56	51	47	47	58	43	38	57	101		52.1	

Note: 0.00 values are less than 0.005